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ABSTRACT

This is a workbook for students learning advanced blueprint reading for heating, ventilation, and air conditioning applications. The workbook contains eight units covering the following material: architectural working drawings; architectural symbols and dimensions; basic architectural electrical symbols; wiring symbols; basic piping symbols; ducting symbols; heating and refrigeration symbols; and isometrics, sections, and detail drawings. An overall final test is included. Each unit contains an objective and performance indicators, introduction, information sheets, self-assessment quiz with answers provided, and a study guide including references for further information. The materials are illustrated with line drawings. (KC)

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ED204544

Advanced Print Reading

Heating, Ventilation and Air Conditioning

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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CE029455

- Architectural Working Drawings
- Architectural Symbols and Dimensions
- Basic Architectural Electrical Symbols
- Wiring Symbols
- Basic Piping Symbols
- Ducting Symbols
- Heating and Refrigeration Symbols
- Isometrics, Sections and Detail Drawings

INDIVIDUALIZED LEARNING SYSTEMS

Drafting

Plot Plans

Floor Plans

Foundation Plans

Elevations

Details

Interior Elevations

Mechanical Plans

Goal:

The student will know the technical names of various construction drawings.

Performance Indicators:

1. Given incomplete statements which describe various types of drawings and a list of descriptive words, the student will select the proper word to complete the statement.

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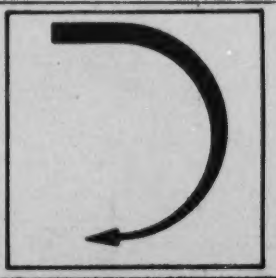
Introduction



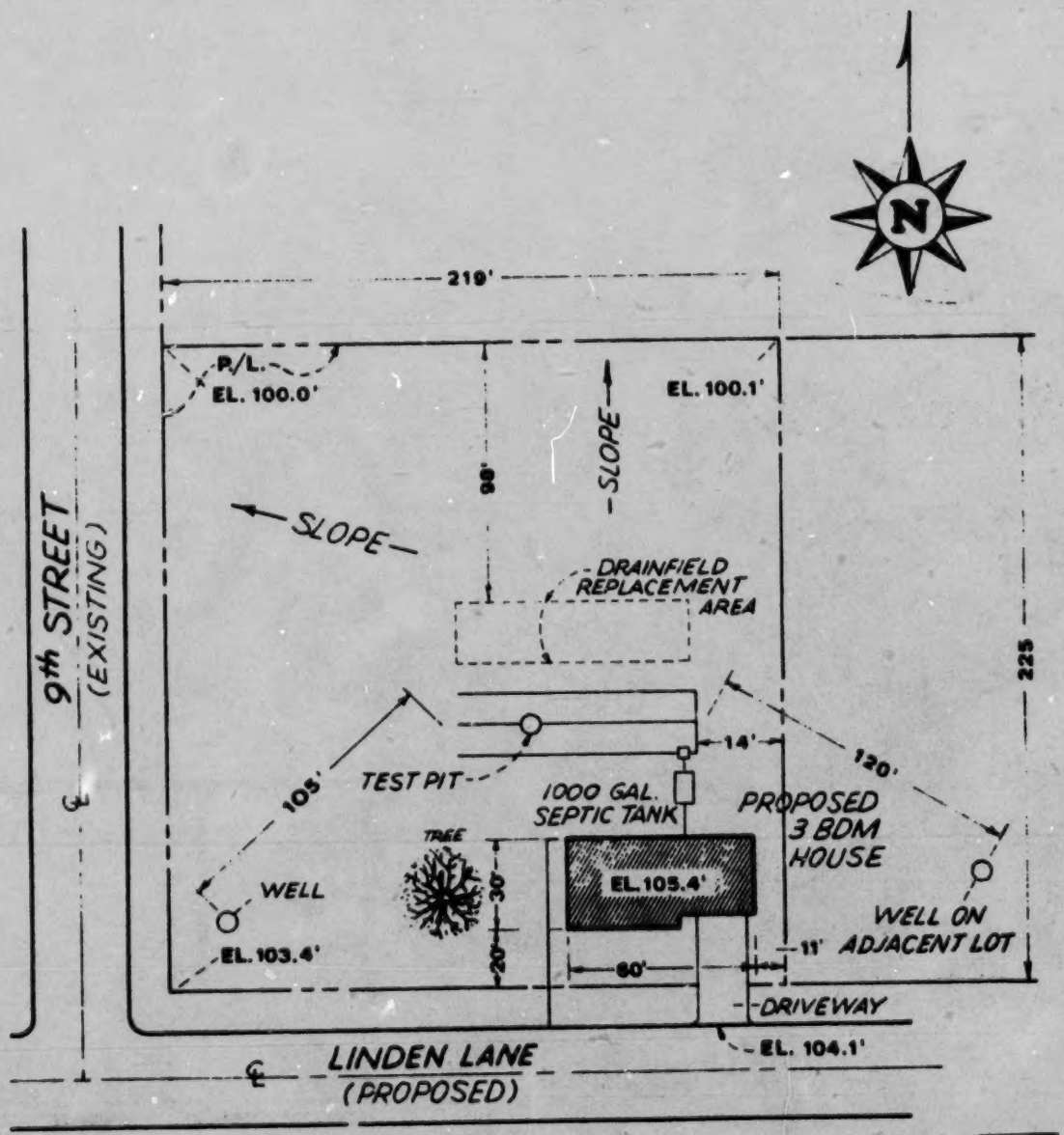
Working drawings are those used by craftspeople and technicians to complete the construction of a residence or other structure.

Drawings for the heating, ventilating and air conditioning trades are normally part of the working drawings for a residence or building. They are seldom drawn expressly for the heating ventilation or air conditioning contractor. Therefore, these contractors must work closely with designers and general contractors to insure that every contigency of the systems they are involved with is considered.

For convenience, the term "HVAC" is used as an abbreviation for heating, ventilating and air conditioning. HVAC drawings may also be referred to as mechanical system drawings by architects and designers.

It is assumed that students have some basic knowledge of architectural print interpretation and HVAC systems. A basic review of architectural working drawings, symbols and dimensions are contained in this material. However, it is not a complete architectural or construction print reading manual.

Information

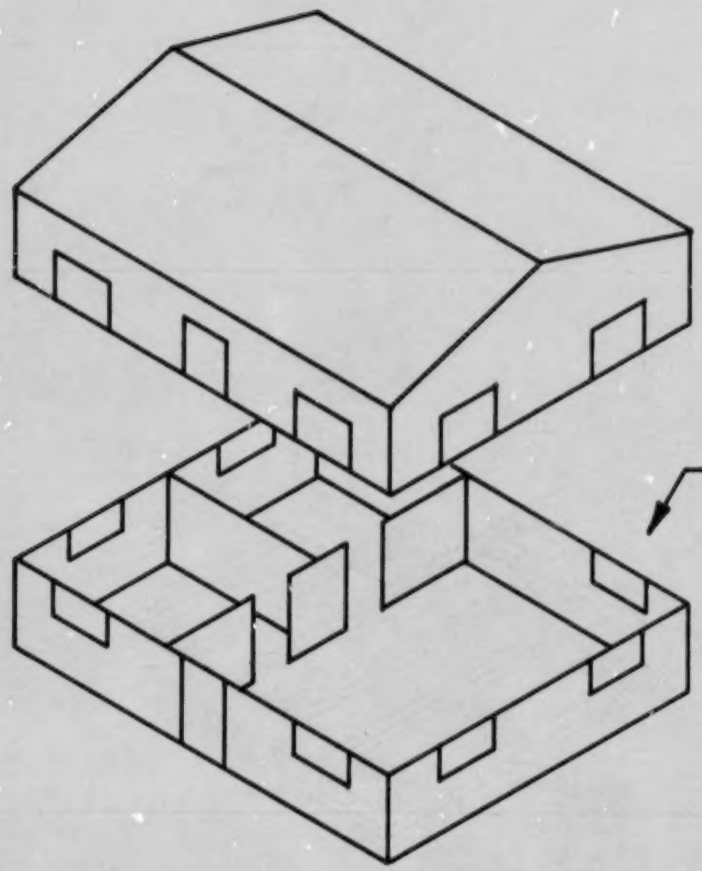


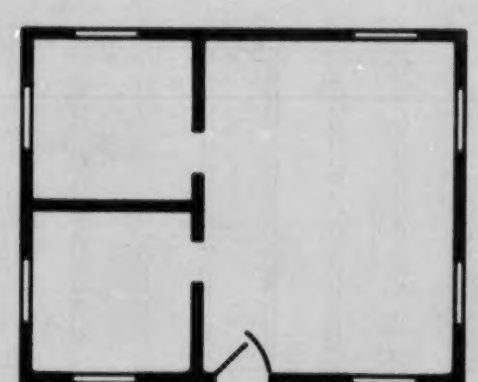
PLOT PLAN

2. FLOOR PLAN

The floor plan contains the information most needed for construction of a building. It shows the layout and sizes of rooms, placement of doors and windows, location and size of cabinets and appliances. All the necessary dimensions for locations and sizes of partiton and bearing walls and a variety of other items of information.

The floor plan is actually a section through the walls of a building, shown in plan view.

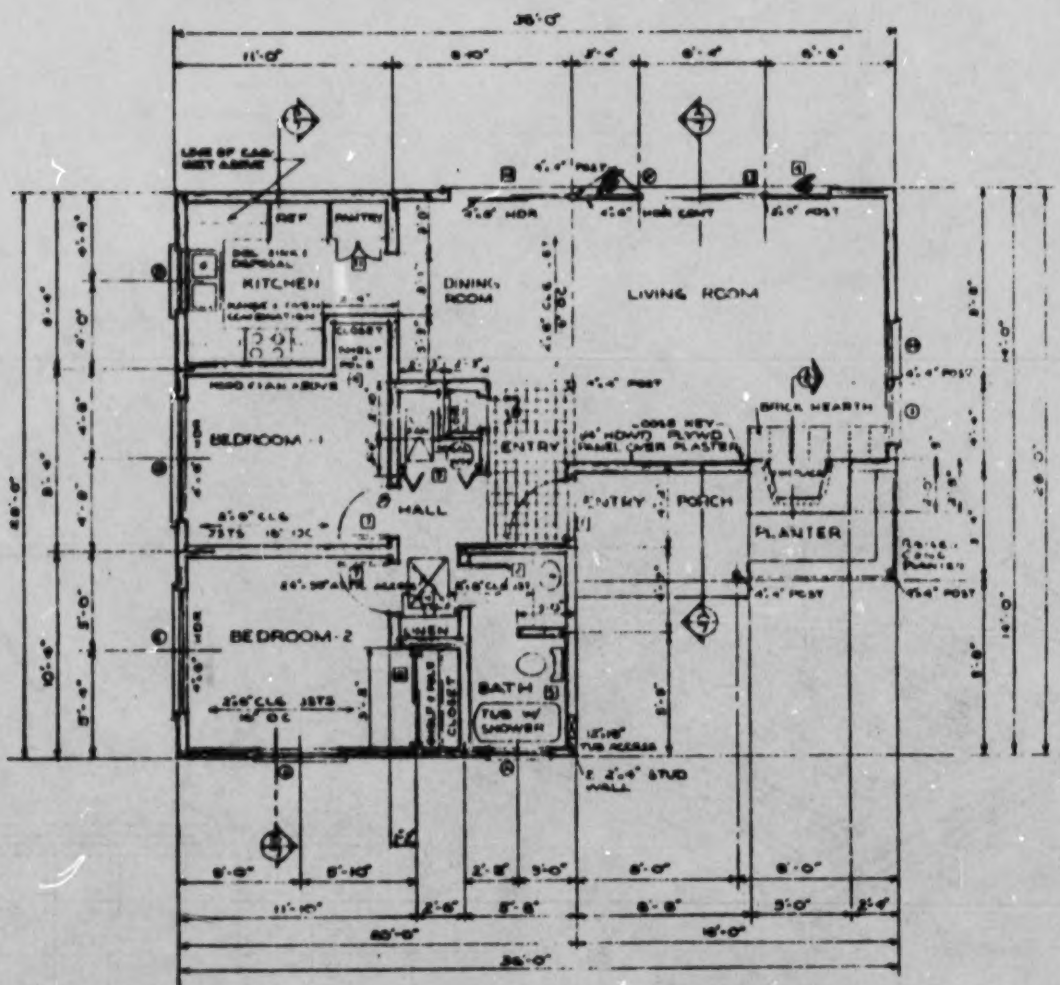




FLOOR PLAN

6

An example of a floor plan is shown below.

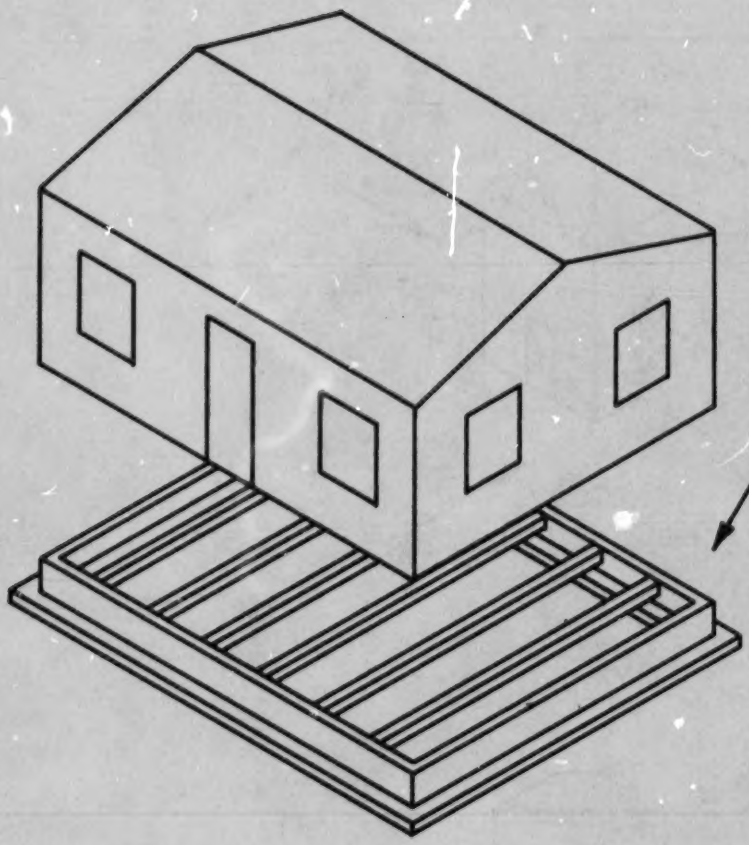


FLOOR PLAN
Scale: 1/4" = 1'0"

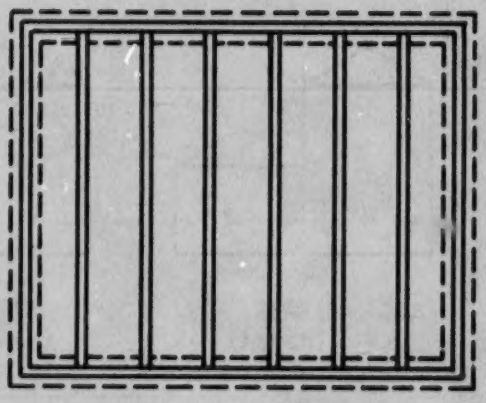
3. FOUNDATION PLAN

The foundation plan may also include the basement plan. It consists of another section shown in plan view. The section is taken just below the first floor.

Foundation plans show the concrete foundation, footings, slabs, girders and posts, air vents, access doors and dimensions for size and location. The mechanical system may also appear on the foundation plan.



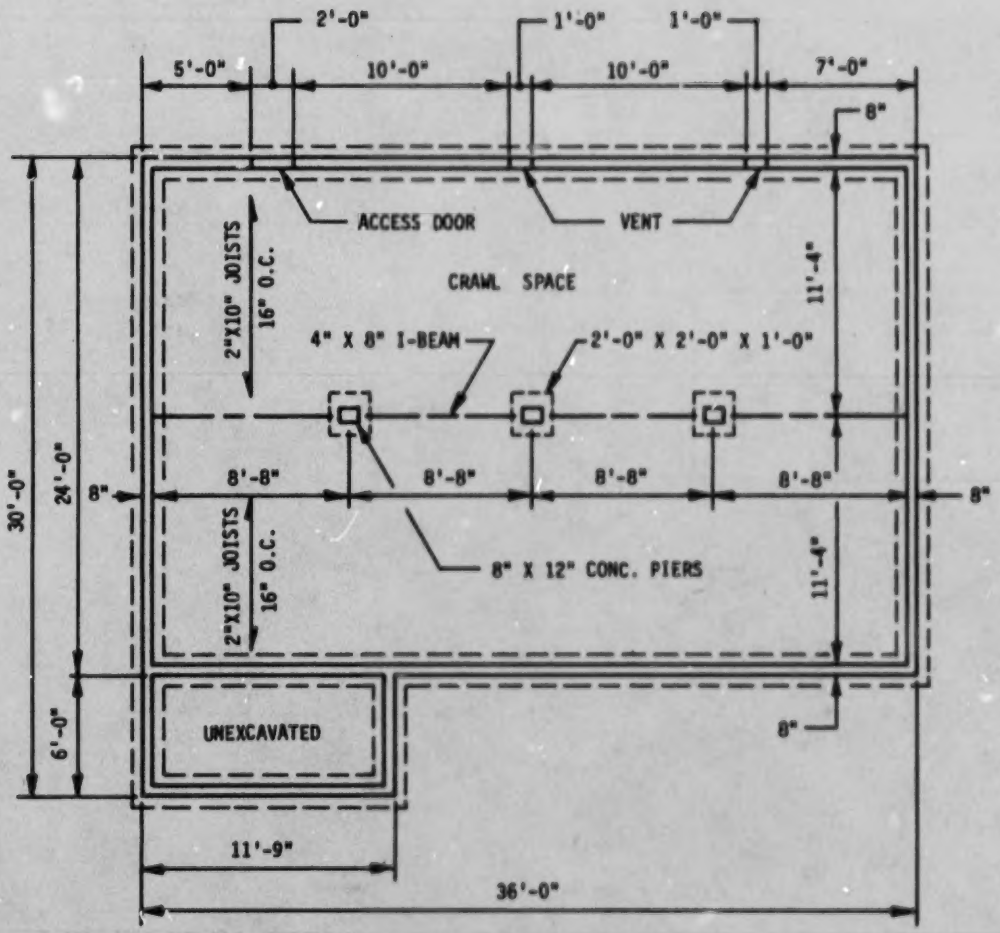
Plan View



FOUNDATION PLAN

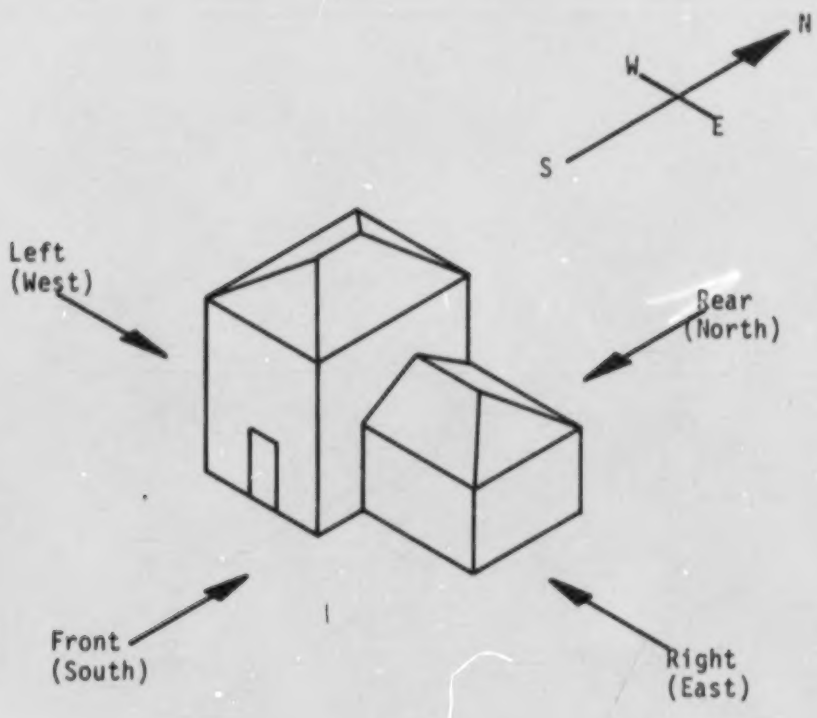
8

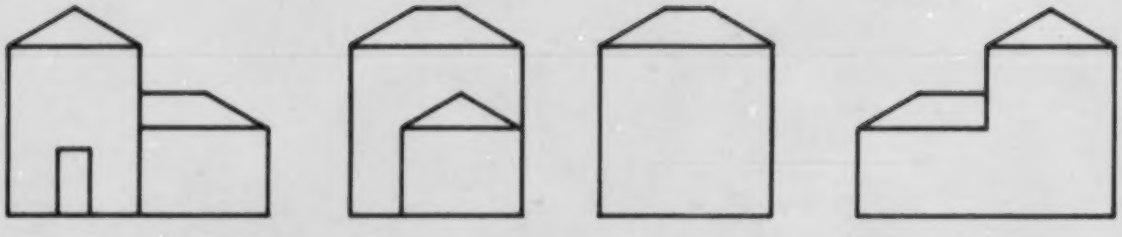
An example of a foundation plan is shown below.



4. ELEVATIONS

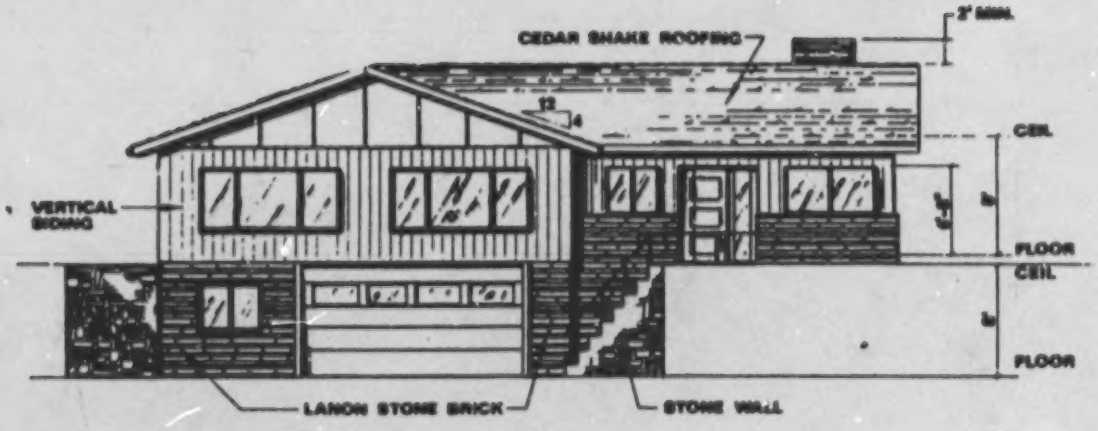
Elevations show the exterior sides of the building as they would appear viewed from the front, right side, rear and left side. They may be labeled in this manner or as they would appear looking at the four points of the compass: north, east, south and west.





FRONT (south) | RIGHT (east) | LEFT (west) | REAR (north)

An example of a front elevation is shown below.

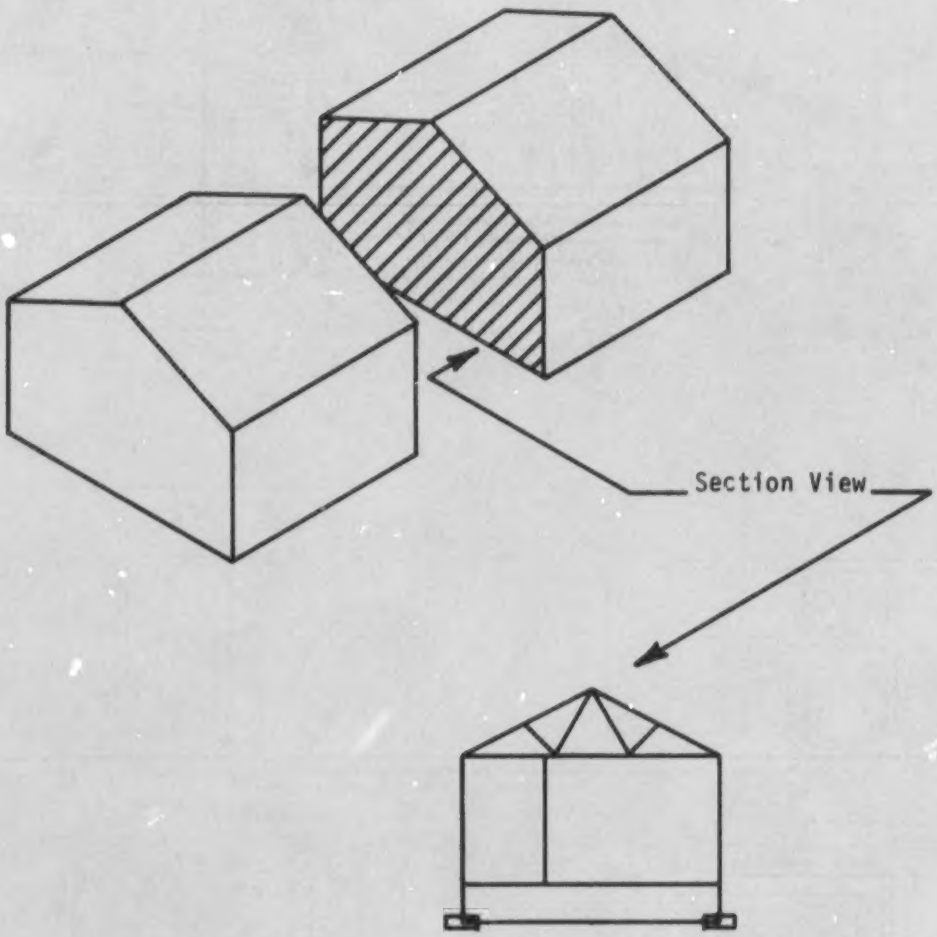


FRONT ELEVATION

5. DETAILS

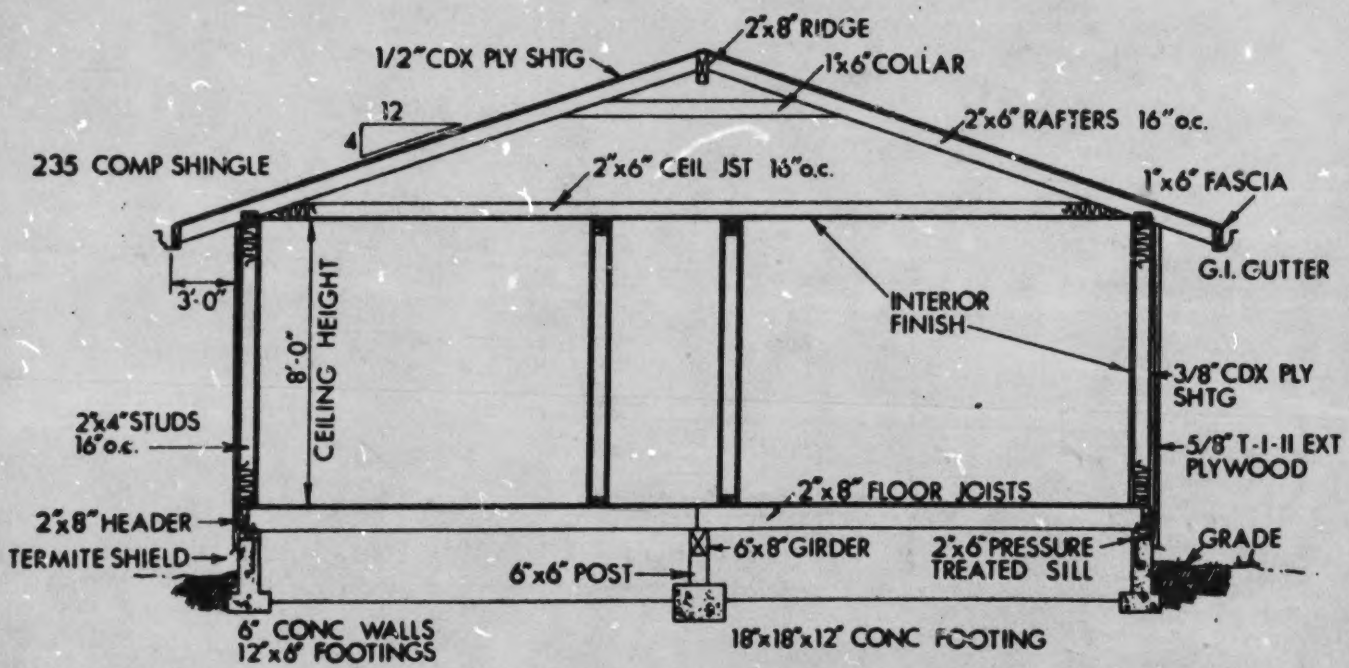
Detail drawings show the particular techniques and materials required to construct various parts of a building. They may include framing details, concrete details, sections, floor framing plans, roof framing plans, beam details, column details or any number of other construction areas which may require more information than is contained on the floor plan.

Sections may be taken at any point through the building. They may be full sections, off-set sections or broken out sections.

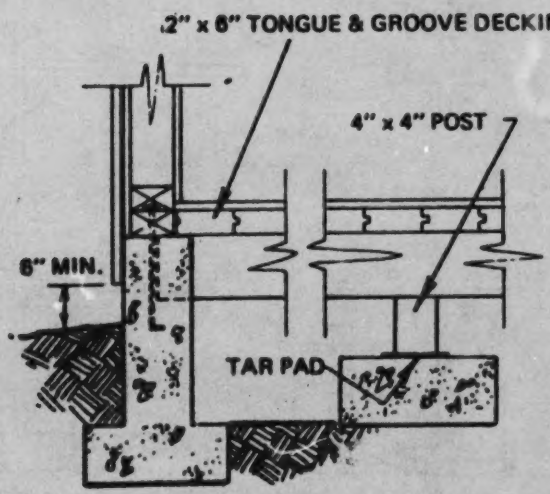


TYPICAL SECTION

Some examples of common details are shown below.



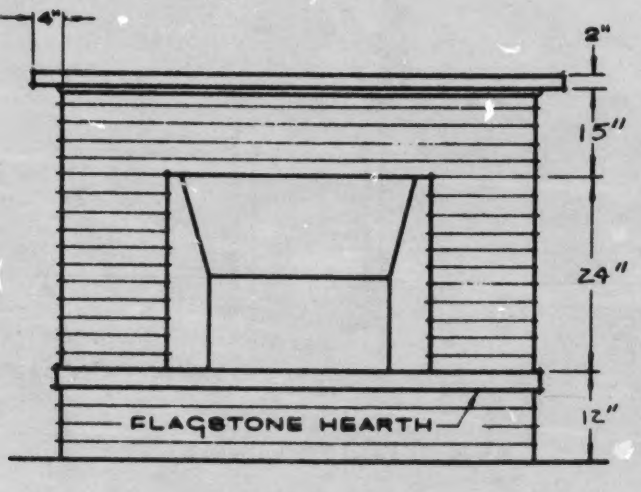
TYPICAL FRAMING SECTION



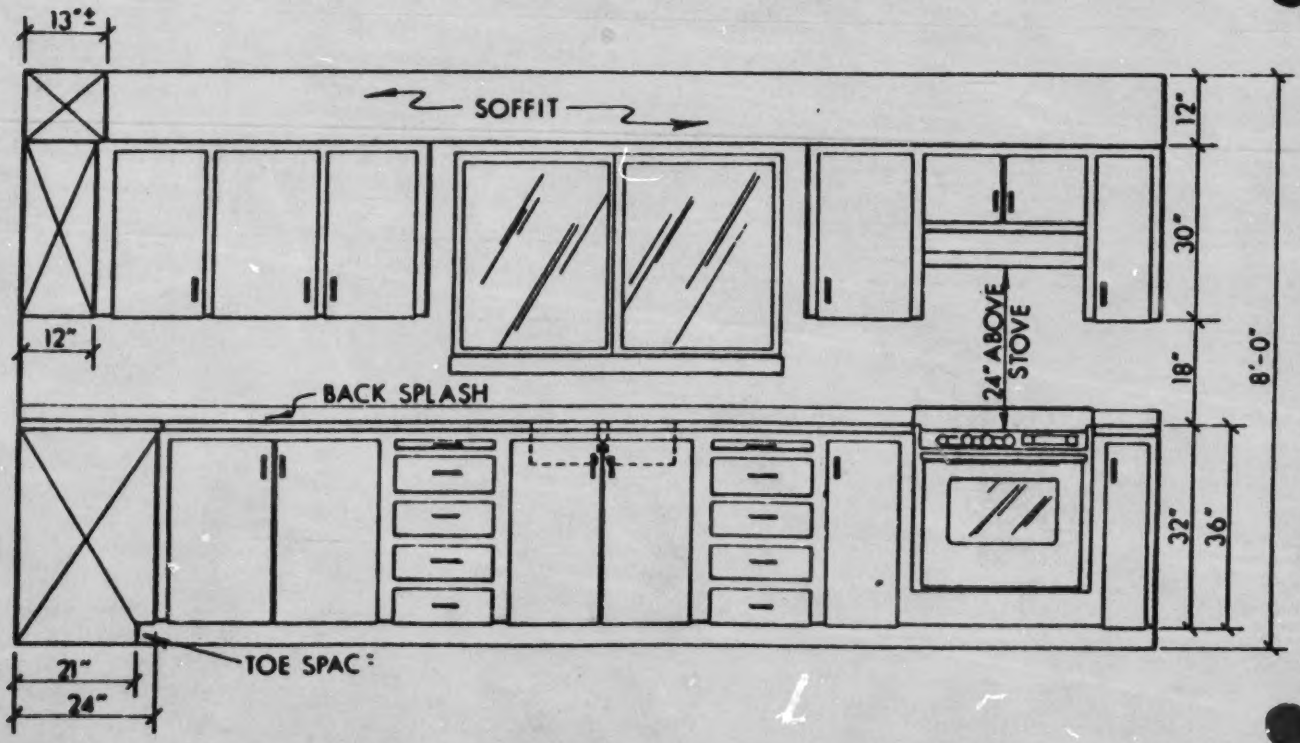
FOUNDATION DETAILS

6. INTERIOR ELEVATIONS

Interior elevations show cabinet walls, fireplaces and special walls as they would appear from inside the rooms. Some examples are shown below.



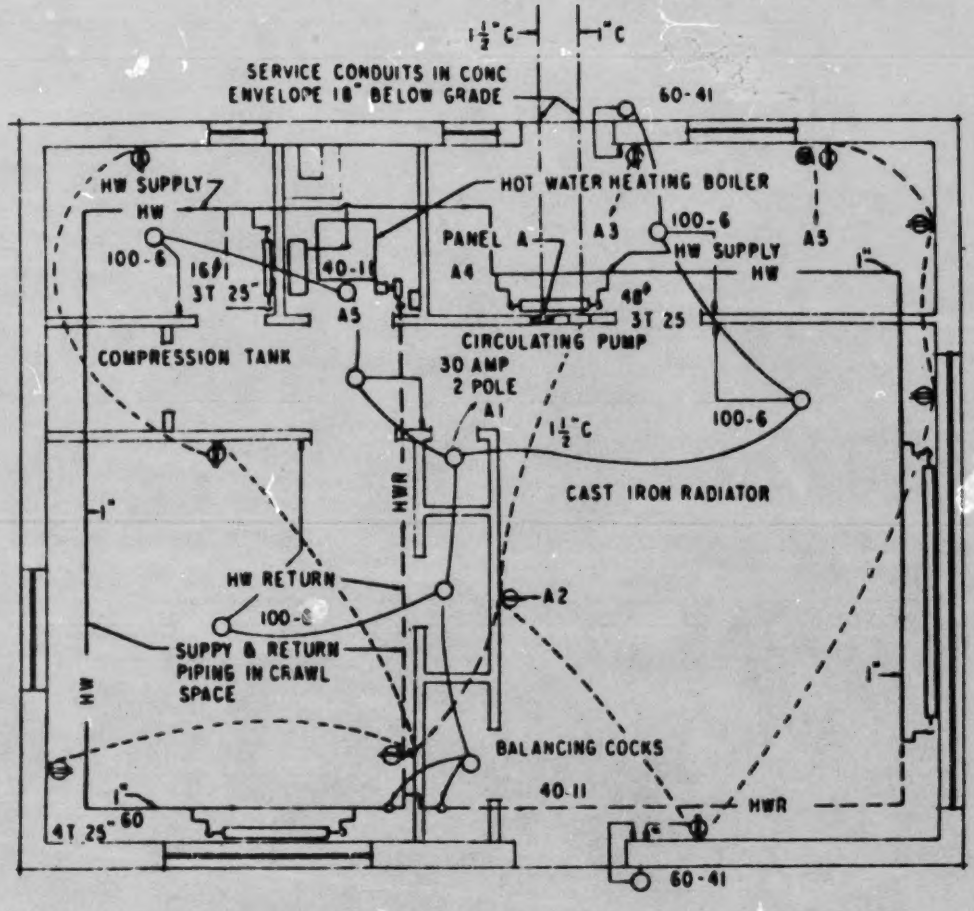
FIREPLACE ELEVATION



TYPICAL KITCHEN CABINET ELEVATIONS AND DIMENSIONS

7. MECHANICAL PLANS

Mechanical plans include electrical, plumbing, heating, ventilation and air conditioning plans. They may be superimposed or combined with other information on the floor plan, foundation plan or basement plan. If the mechanical systems become complex enough, they are drawn separately or combined on a simplified floor plan or foundation plan.



COMBINED MECHANICAL PLAN

Self Assessment

Directions: Complete the following sentences.

1. The _____ plan describes the property on which a building will be constructed.

2. The _____ plan shows the layout and sizes of rooms.

3. The _____ plan shows the concrete foundation and concrete slabs.

4. The front _____ shows the exterior of the building as it would appear from the front side.

5. _____ show portions of the building as if they were sliced through.

6. _____ elevations show the inside walls and cabinets in a building.

7. _____ plans show electrical, plumbing, heating, ventilation, and air conditioning systems or circuits.

Answers:

1. Plot; 2. Floor; 3. Foundation; 4. Elevation; 5. Section or Details; 6. Interior; 7. Mechanical

Study Guide

For Further Information:

Architecture, Design-Engineering-Drawing, Spence, 1972.

Architectural Drawing and Light Construction, Mueller, 1967.

ILS Drafting: Architectural, articles 40.07, 42.05

INDIVIDUALIZED LEARNING SYSTEMS

Drafting

Floor Plan Symbols

Dimensions

Schedules

Goal:

The student will know some of the symbols used on architectural drawings.

Performance Indicators:

Given graphic representation of various architectural symbols, the student will correctly identify them.

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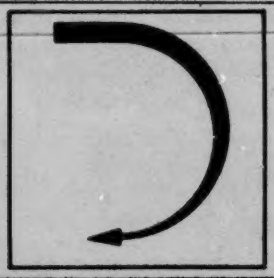
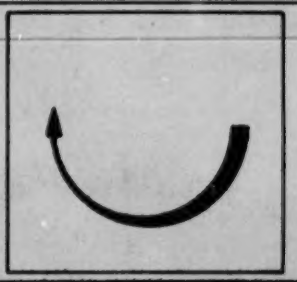
Introduction



Framing members, walls, cabinets and other features are depicted on architectural drawings by using a series of standard symbols. These symbols help simplify the drawings and increase readability.

The dimensioning techniques used on architectural drawings differ from those used on mechanical drawings. These differences may be very subtle, but it is important that you understand and recognize them.

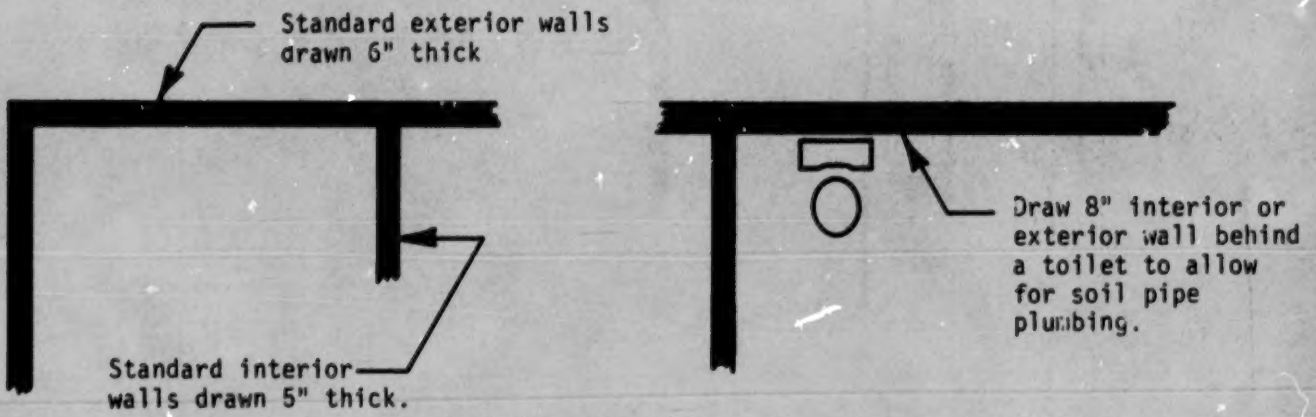
• Information



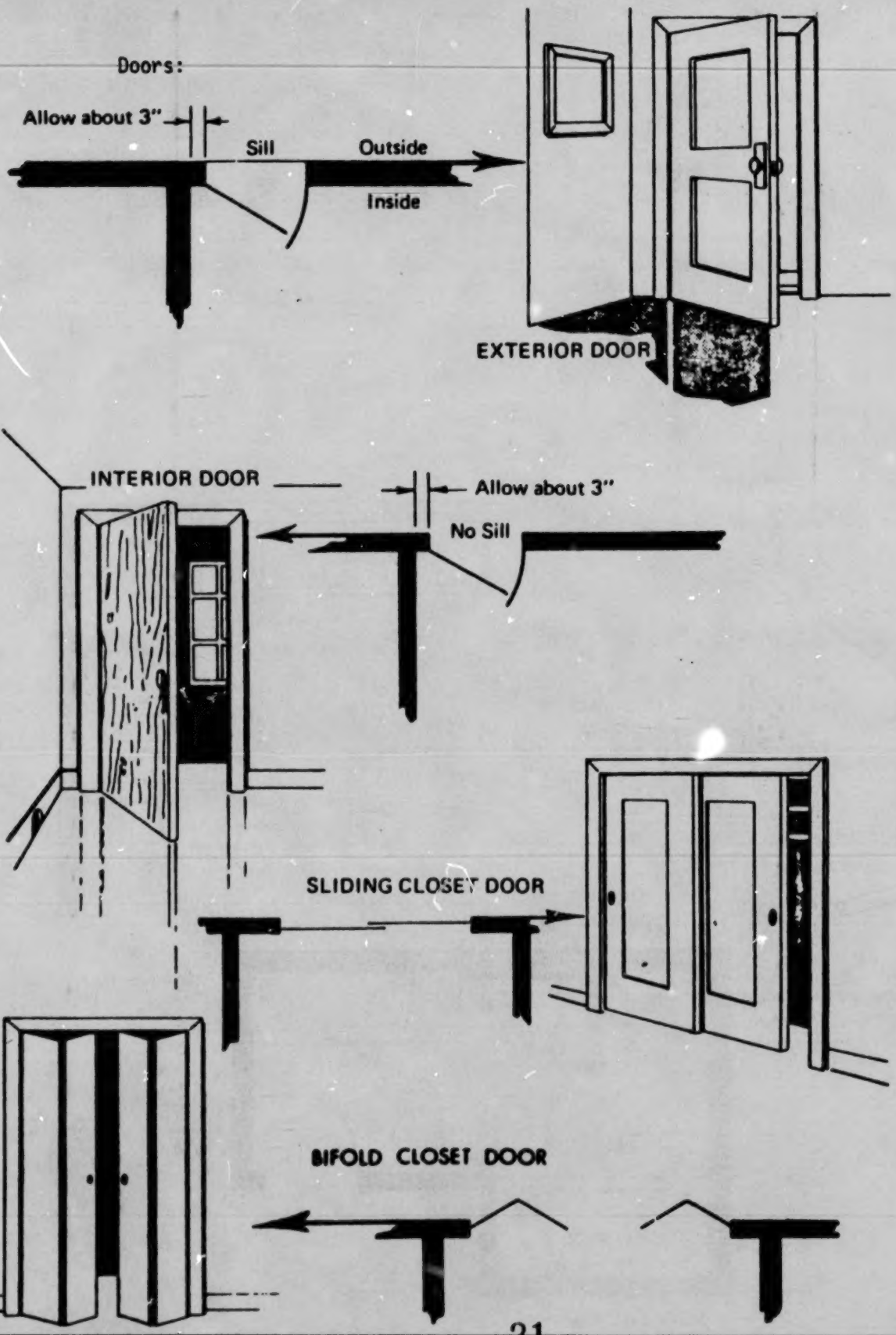
1. FLOOR PLAN SYMBOLS

Doors, windows, walls, cabinets, closets and stairs are all shown on the floor plan with symbols. These symbols describe size, type and locations of the features:

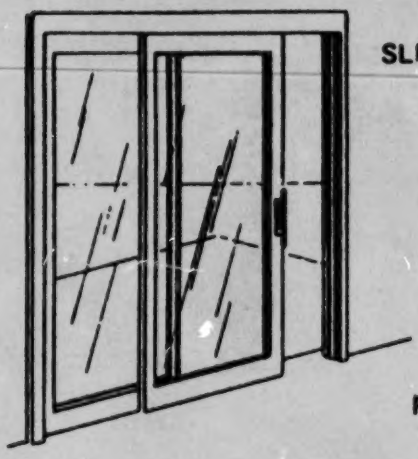
Walls:

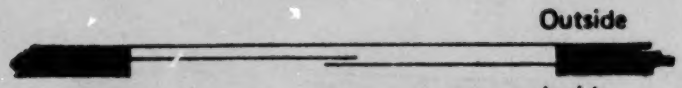

Standard exterior walls drawn 6" thick
Standard interior walls drawn 5" thick.
Draw 8" interior or exterior wall behind a toilet to allow for soil pipe plumbing.

Walls may be blackened in or one of the following symbols may be used.

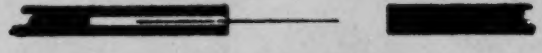

Doors:
Allow about 3"
Sill
Outside
Inside
EXTERIOR DOOR
INTERIOR DOOR
Allow about 3"
No Sill
SLIDING CLOSET DOOR
BIFOLD CLOSET DOOR

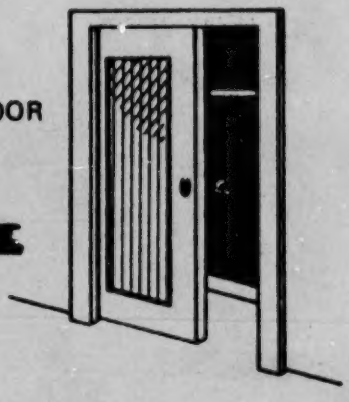
SLIDING GLASS (PATIO) DOOR





POCKET SLIDING DOOR

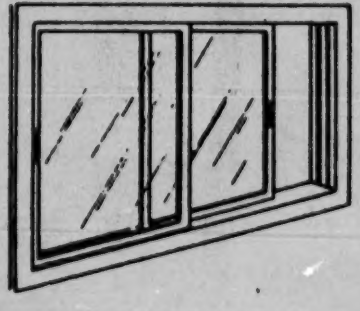




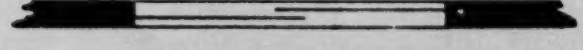
There are many other door symbols, but these are the most common. If you need others, see your references.

Windows:

SLIDING WINDOW

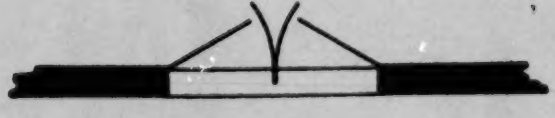


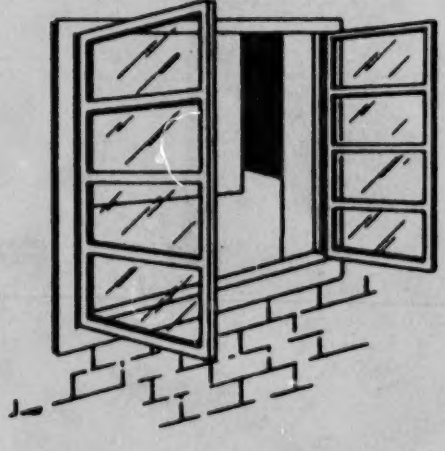
There is a sill on the inside



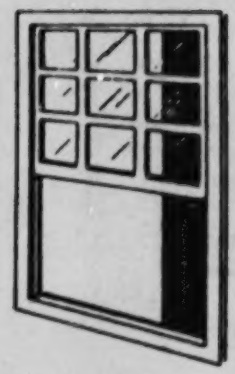
and on the outside of windows.

CASEMENT WINDOW

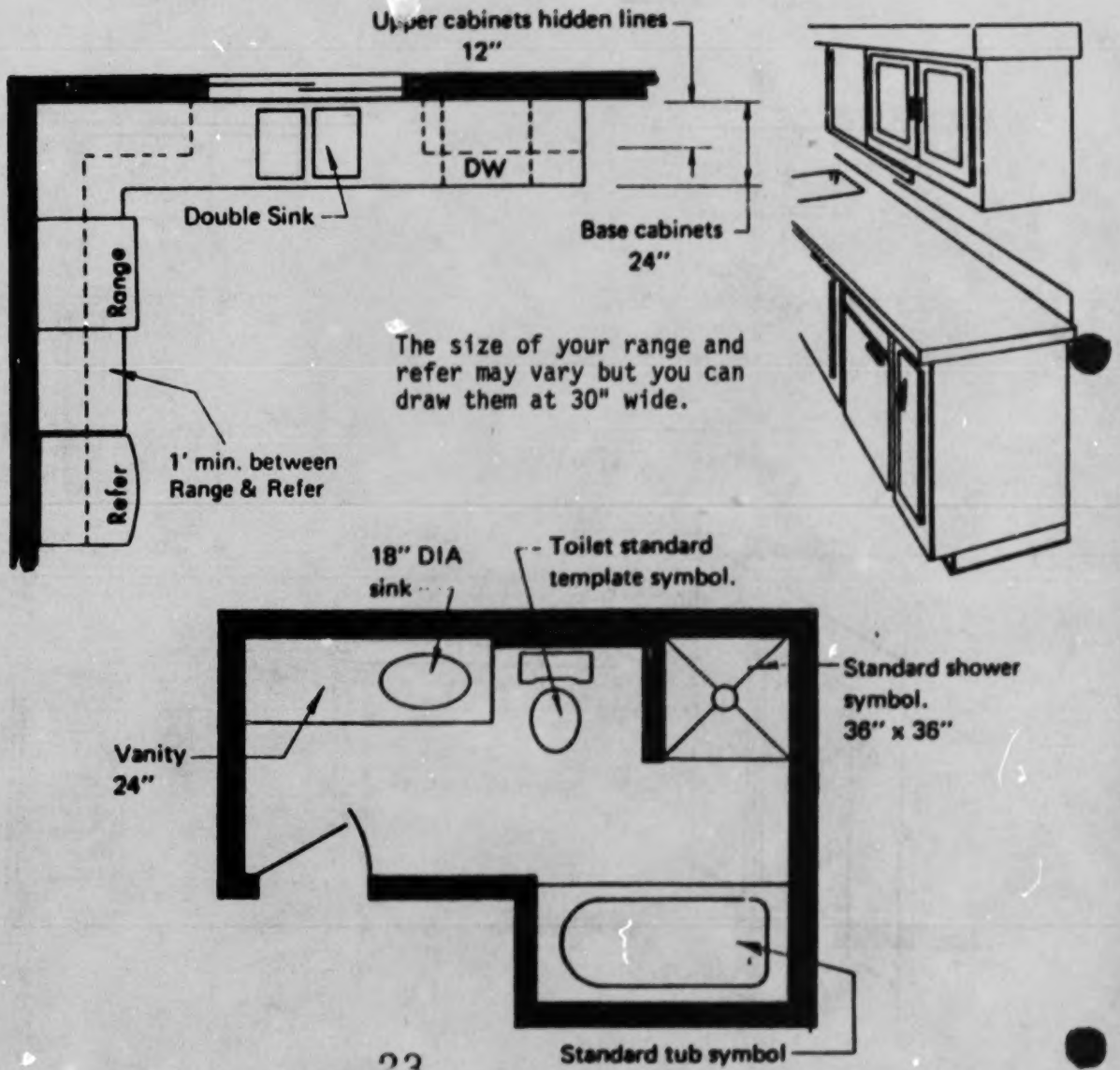




DOUBLE HUNG WINDOW



Cabinets & Fixtures:



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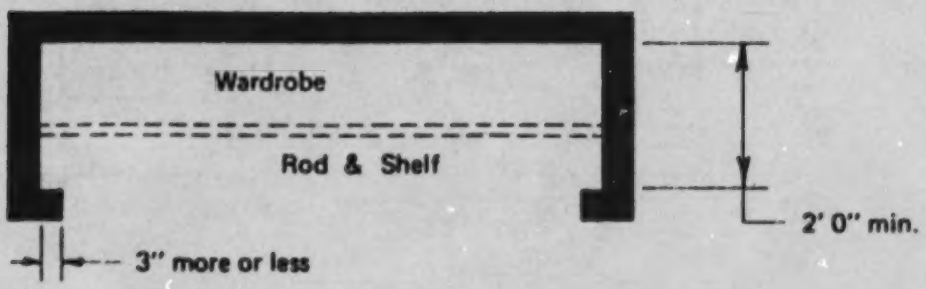
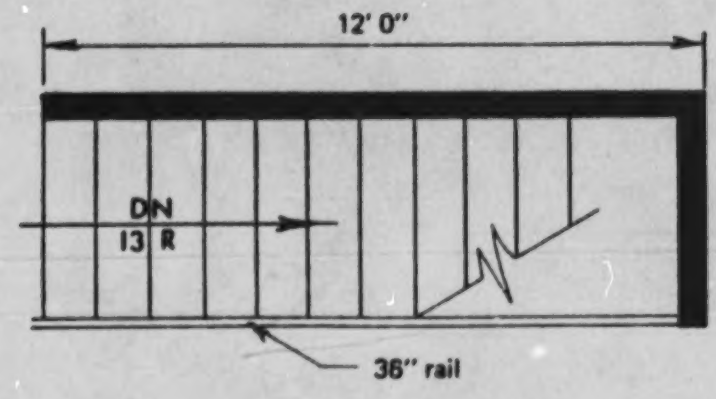
Closets:



A minimum single wall walk-in closet might be 5'0" wide by 5'6" long, and a minimum double wall could be 7'0" wide x 5'6" long.

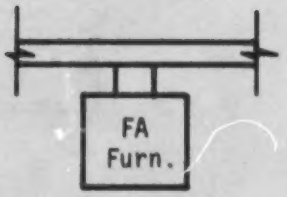
Stairs:



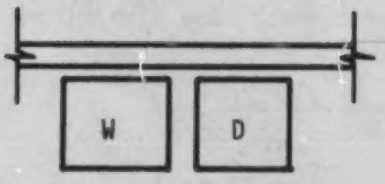
Stairs in plan only show the direction and number of risers and wall lengths.

MISCELLANECUS SYMBOLS

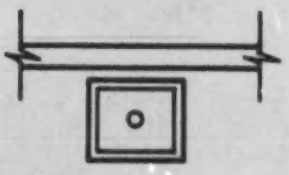
Hot Water Heater



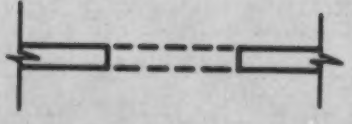
Forced Air Furnace



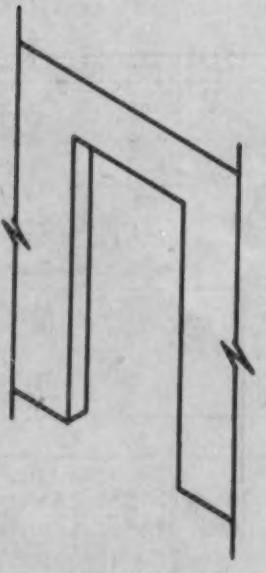
Washer & Dryer



Laundry Sink



Arched Doorway



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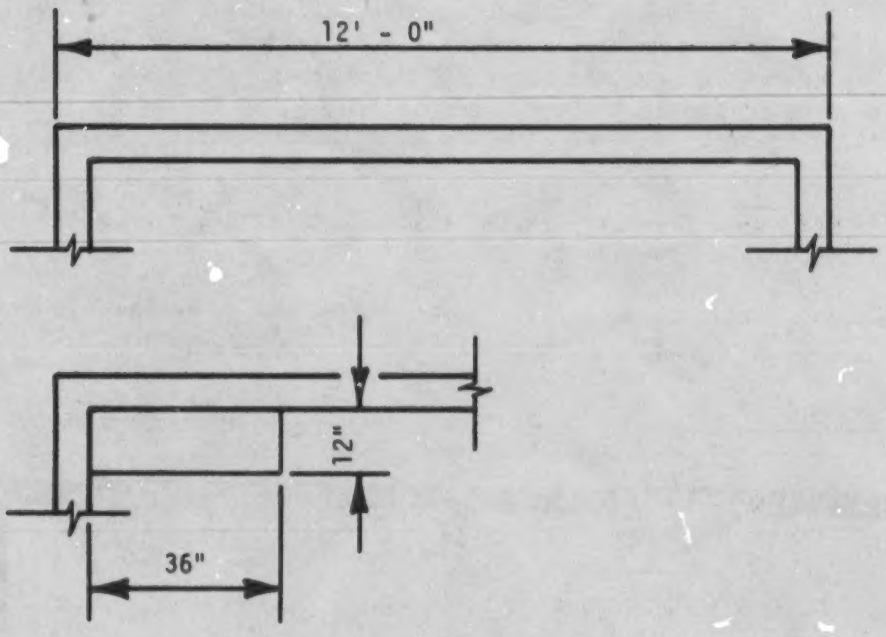
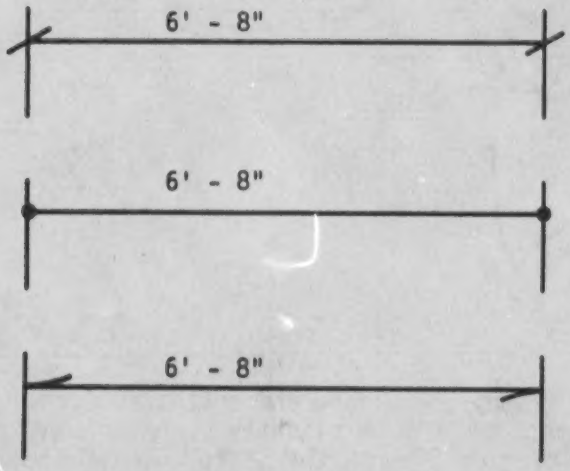
2. DIMENSIONS

Architectural dimensions are always given in inches for measurements up to six feet and in inches and feet for measurements over six feet.

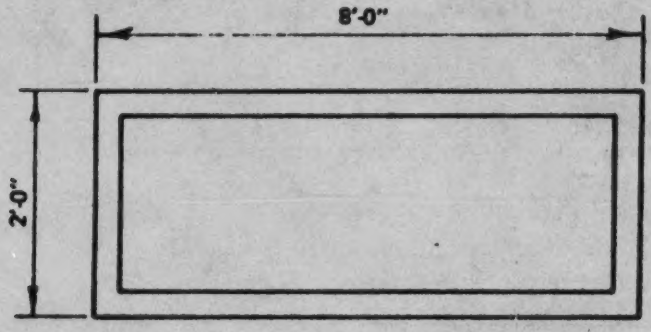
The dimension line is not broken as it is in mechanical drawing and the dimension is placed above the dimension line.



Dimension lines may be capped with arrowheads where they meet the extension lines, or they may be like this:

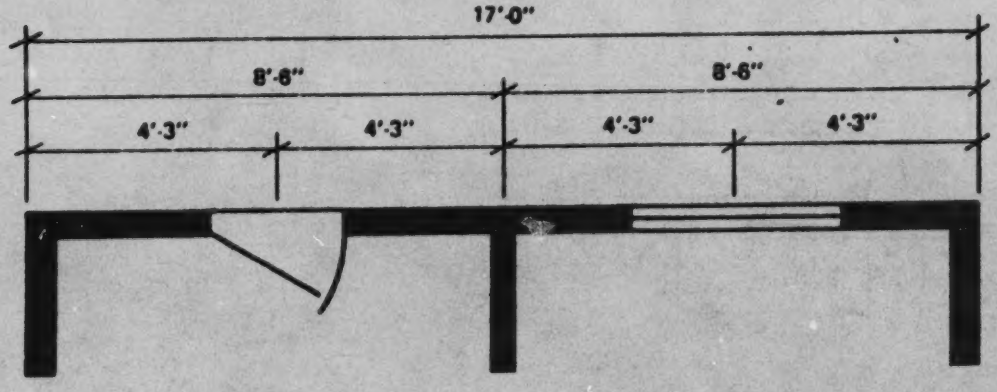


Aligned dimensioning is used so that the dimensions read from the bottom and right side of the sheet.

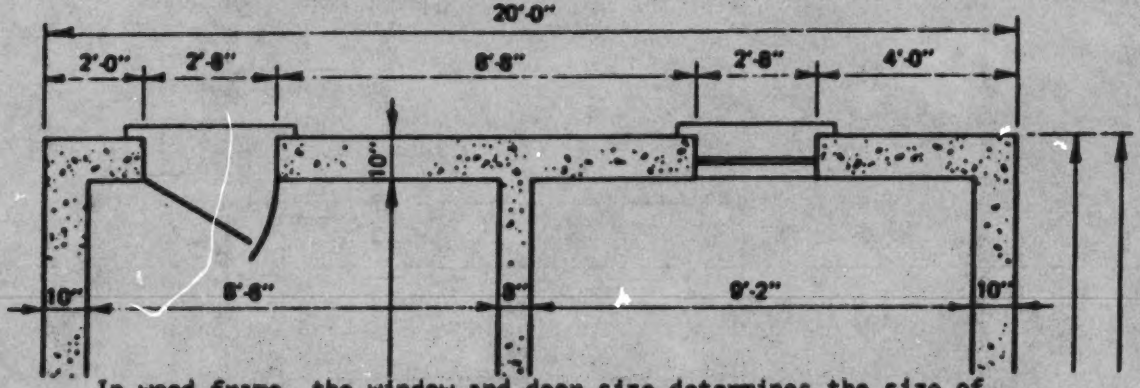


The overall dimensions on frame construction are given to the outside of the stud frame, because that dimension is used first, before the sheathing and other wall covering is applied.

In this wood frame structure, dimensions of interior walls, windows, and doors to the centers.



When you see dimensioning for concrete or masonry construction as in a residential basement, then you may see it like this:



In wood frame, the window and door size determines the size of the opening and may be slightly oversize, but in concrete the size is critical, hence the difference in dimensioning.

3. SCHEDULES

- Schedule Setup

A schedule is a chart of materials or products with size, description, quantity, and any other information needed to construct or finish the building.

Schedules aid a drawing by keeping the drawing clear of unnecessary notes. Items that can be keyed to the drawing and placed in a schedule, such as windows and doors, should be considered. There are many different ways to set up a schedule; here is a simple example.

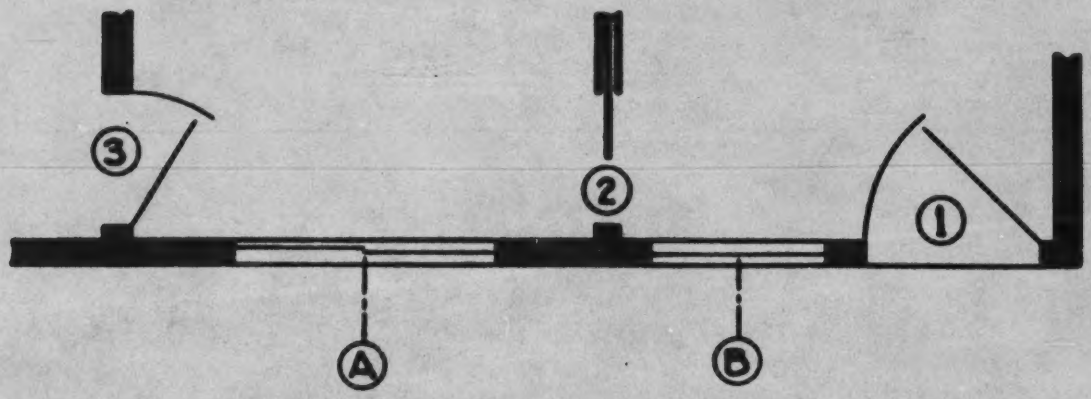
DOOR SCHEDULE

KEY	QUANT	SIZE	DESCRIPTION
1	2	3'0" x 6'8"	Solid Core
2	6	2'8" x 6'8"	Hollow Core
3	4	6'0" x 6'8"	Bi-Fold Closet
4	2	8'0" x 6'8"	Glass Sliding-Safety
5	1	2'8" x 6' "	Pocket Sliding

This example gives only the minimum information, others tell material and remarks about the product.

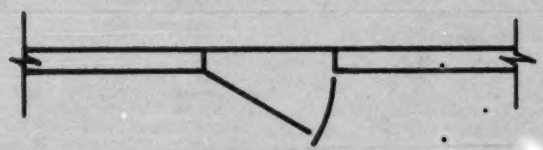
- Schedule Key

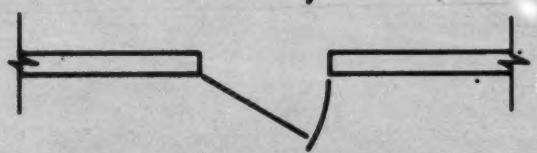
The doors and windows must be keyed to the schedule. This can be done by labeling the doors with a number and the windows with a letter. You can also use different geometric features; like this (1) (2) ⬡1 ⬡2 . Or, you can consider labeling windows with a (W) and doors with a (D), like this ⊕W1 ⊕W2 ⊕W1 ⊕W2 . Look at Figure 1.

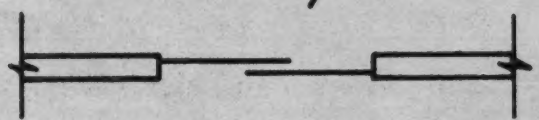


Self Assessment

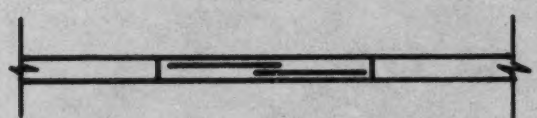
Directions: Identify the following symbols.

(1) 

(2) 

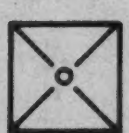
(3) 

(4)

(5) 

(6)

(7)

(8) 

(9)

(10)

(11)

(12)

Answers:

(1) Exterior Door; (2) Interior Door; (3) Sliding Closet Door;
(4) Bi-Fold Door; (5) Sliding Window; (6) Casement Window;
(7) Water Closet; (8) Shower; (9) Stairs; (10) Water Heater;
(11) Arched Doorway; (12) Forced Air Furnace;

Study Guide

For Further Information:

Architecture, Design-Engineering-Drawing, Spence, 1972.

Architectural Drawing and Light Construction, Mueller, 1967.

ILS Drafting: Architectural, articles 40.02, 40.03, 45.01

INDIVIDUALIZED LEARNING SYSTEMS

Drafting

Lighting Symbols

Switch Symbols

Electrical Outlets or Receptacles

Basic Switching Arrangements

Miscellaneous Symbols

Abbreviations

Goal:

The student will know hardware symbols used on typical electrical and mechanical plans.

Performance Indicators:

Given graphic illustrations of electrical, plumbing and heating symbols, the student will identify the item represented by the symbol.

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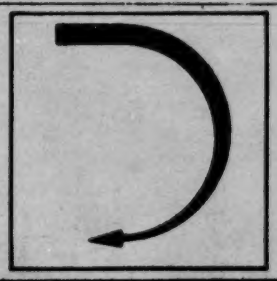
Introduction



Since most electrical plans are those used with architectural type drawings, the main emphasis will be on symbols used in this type of electrical plan.

Unlike the symbols used in most electronic schematic diagrams, the symbols for architectural drawings describe a total piece of hardware or a unit of electrical components. Most of the symbols are simple, for example, circles or squares, with an identifying letter or letters to help distinguish one symbol from the next.

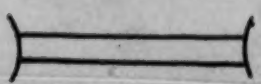
Electrical and mechanical plans may be included with the information on floor plans and foundations or they may be separate plans drawn on simplified floor plans and foundation plans. They are necessary to provide contractors with information for estimating, bidding, and installing the electrical and mechanical systems for a structure.

Information

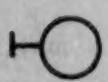
1. Lighting Symbols

There are two common types of lighting fixtures used in most structures. The incandescent and fluorescent lamp are the most frequency used fixtures in most residences and light commercial buildings. The basic symbols are shown below.

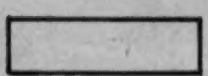
incandescent lamp
ceiling mounted



fluorescent strip



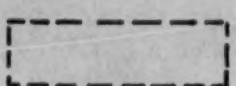
incandescent lamp
wall mounted



fluorescent fixture

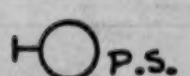
A light fixture that is recessed in the ceiling would have a dashed line indicating the basic shape of the fixture, for example:

recessed incandescent lamp

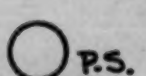


recessed fluorescent lamp

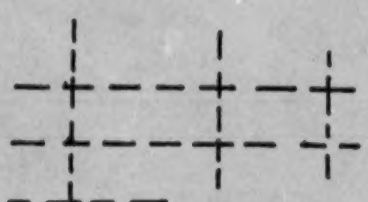
Some of the other lighting symbols are shown below.



wall mounted lamp
w/pull switch



ceiling mounted lamp
w/pull switch



suspended, lighted
ceiling panels

2. Switch Symbols

The basic switch symbol for a typical lighting circuit is merely the letter "S" placed on the plan in the position where the switch is to be located. Switches that control more than one circuit or that work in conjunction with other switches are indicated by the number "3" or "4" placed by the letter "S".

S — basic switch symbol

S_3 — three-way switch

S_4 — four-way switch

Some of the other switch symbols:

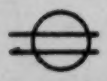
S_P — switch with a pilot light

S_T — toggle switch with thermol circuit protector (fused)

Other identification letters may be used with a table or legend to indicate their meanings.

3. Electrical Outlets or Receptacles

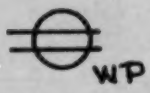
The basic electrical outlet with two receptacles is known as a duplex receptacle. The symbol is shown below.



duplex receptacle

Modifications to the basic duplex receptacle symbol include those for water proof outlets, switch and receptacle combinations and receptacles with one outlet controlled by a switch.

weatherproof

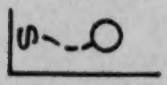


switch-receptacle combination

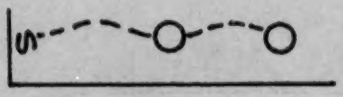
receptacle w/one outlet controlled by a switch

4. Basic Switching Arrangements

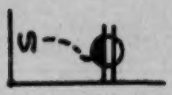
A dashed line from the switch to the receptacle or lamp fixture indicates the basic wiring for these fixtures.



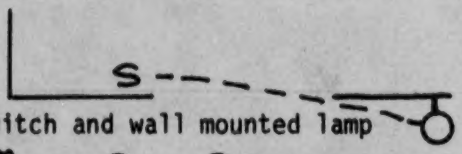
single switch and lamp



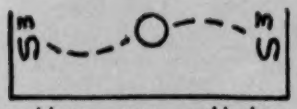
single switch and two lamps



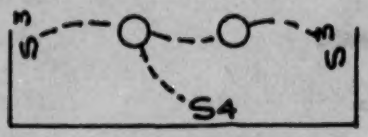
switch and receptacle



switch and wall mounted lamp



two three-way switches and a single lamp



two lamps controlled by three switches

5. Miscellaneous Symbols

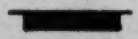
There are many other symbols used on electrical plans. A few are shown below.

receptacle, mounted flush with the floor

Door bell or chime push buttom

Buzzer

Junction Box



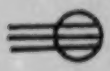
Power or light panel

Smoke Detector

Special outlet (identified with letters)

Bell

Telephone outlet

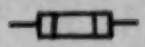


240 Volt Receptacle

Motor connection

Fan Connection

Circuit Breaker



Fuse

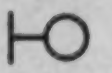
6. Abbreviations

CB	-	circuit breaker	F	-	fan
AFF	-	above finished floor	Tel	-	telephone
CSP	-	central switch panel	Bus	-	busway
MDP	-	main distribution panel	Cond	-	conduit
Gd	-	grounded	Crct	-	circuit
NL	-	night light	Fdr	-	feeder
R	-	recessed	Fluor	-	fluorescent
WP	-	water proof	KW	-	kilowatt
M	-	motor	PL	-	pilot light

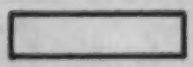
Self Assessment

Directions: Identify the following symbols. Place your answers in the space provided. Check your answers with those on the next page.

(1)

(2) 

(3)

(4) 

(5)

(6)

(7)

(8)

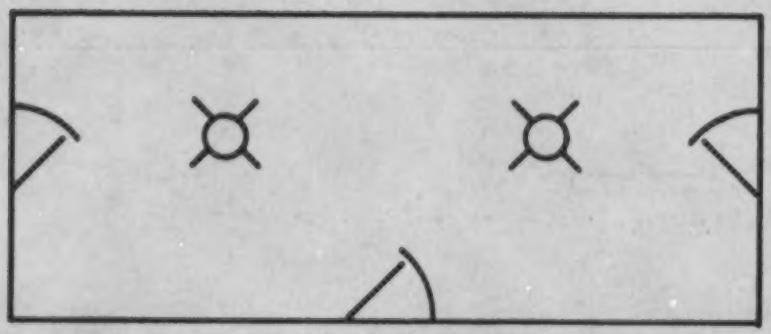
(9)

(10)

(11)

(12)

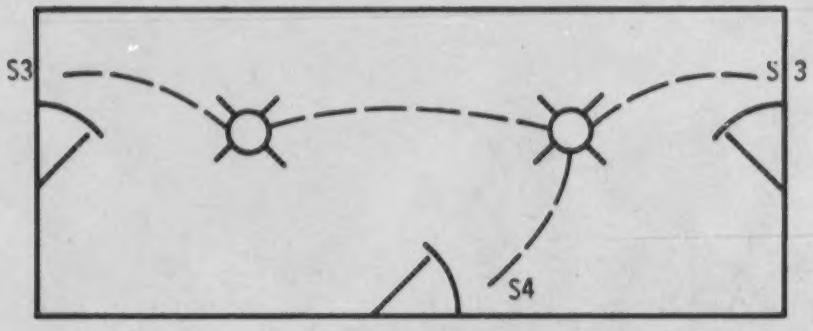
(13) Directions: Sketch the switch arrangement for two ceiling mounted lamps controlled by three switches.



Answers to Self-Test:

(1) Fluorescent Strip; (2) Wall Mounted Lamp; (3) Ceiling Mounted Lamp; (4) Fluorescent Fixture; (5) Recessed Fixture; (6) Wall Mounted Lamp w/Pull Switch; (7) Switch; (8) Three-Way Switch; (9) Duplex Receptacle; (10) Waterproof Receptacle; (11) Floor Mounted Receptacle; (12) Junction Box;

(13)



Study Guide

For Further Information:

IEEE Standard and American National Standard, Graphic Symbols for Electrical and Electronic Diagrams, 1971, ANSI V32.2.

Electrical and Electronics Drawings, Baer, 1973.

National Electrical Code, 1975 ed.

National Electrical Code Blueprint Reading, Gibert, 1974.

Electrical Blueprint Reading, Traister, 1975.

Electrical Trades Blueprint Reading, Vol. 1-3, Delmar Publish., 1961.

ILS Drafting: Electrical/Electronics, article 26.00

INDIVIDUALIZED LEARNING SYSTEMS

Drafting

Switches, Contacts and Relays
Circuit Protectors
Conductors
Power Distribution Symbols

Goal:

The student will be able to identify the symbols used in electrical wiring diagrams.

Performance Indicators:

Given graphic illustrations of electrical symbols used in wiring diagrams, the student will identify them by the commonly accepted industry term.

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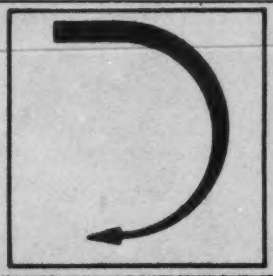
Introduction



All electrical diagrams use symbols to indicate components, contacts and switches. These symbols simplify the diagrams and provide an expeditious means of showing electrical components.

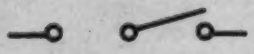
Standards for symbols have been established by the American National Standards Institute. Those standards are reflected in this module.

• Information

1. SWITCHES, CONTACTS AND RELAYS

Electrical wiring diagrams usually contain several switches or switching assemblies. The symbols used in single-line wiring diagrams show each switch and contact in relation to the circuit it controls. The basic switch symbols are shown below.

Single-Throw Switch

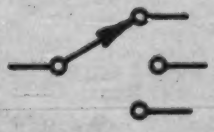


Double-Throw Switch

Double-Pole Double-Throw Switch

Knife Switch

Push Button Switch



Selector Switch

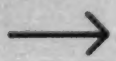
The switches shown above, with the exception of the Selector Switch, are shown in an "open" position. In each case, the switch is "closed" if the symbols are touching, for example:

Single-Throw (Closed)

Push Button (Closed)

As you can see in the switch symbols, the contact is the open-circle portion of the symbol.

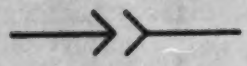
Disconnection type couplings, such as plugs and jacks, have a special symbol which indicates how the connection is made.



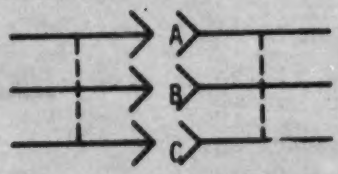
Plug

Jack

Together, these symbols indicate a separable connector.

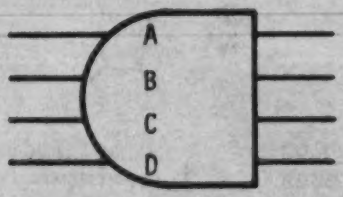


When used in multiples, the symbols indicate several plugs and jacks in one piece of hardware.



The letters are added for identification.

Another symbol that indicates a multiple connection device is shown below.



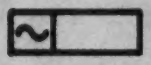
Relays are shown as a square with the letter "R" inside or as a rectangle with an identifying symbol on one end.

Basic Relay Symbol

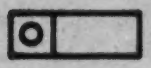
Other letters may be used to identify special characteristics of the relay:

AC - Alternating Current
D - Differential
DB - Double Biased
EP - Electrically Polarized
FO - Fast Operate
FR - Fast Release
P - Magnetically Polarized
SO - Slow Operate
SR - Slow Release

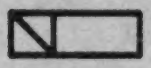
Specific Relay Symbols:



Alternating Current

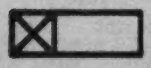


Fast Operate

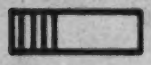


Fast Release

Magnetically Polarized



Slow Operate

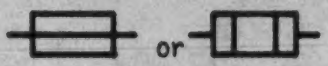


Slow Release

2. CIRCUIT PROTECTORS

Circuit protectors are normally fuses or circuit breakers of various types. The basic symbols are shown below.

Circuit Breaker



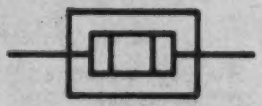
Fuses

NOTE: Sometimes the symbol for a thermal element is used to indicate a thermal-overload fuse.

Thermal Element

Some of the modified symbols are:

High-Voltage Fuses

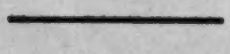


Oil-Type High-Voltage Fuse

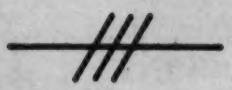
3. CONDUCTORS

Electrical transmission paths are shown in a variety of ways, depending on the type of drawing in which they are used.

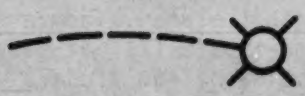
Single-line drawings use symbols that would indicate one, two, three or more conductors or wires. Qualifying letters may also be used to indicate special characteristics of the conductor or wire sizes.



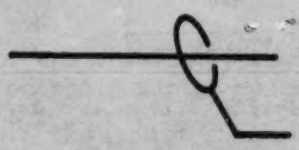
Basic Conductor Symbol



Conductor Symbol for Power Distribution indicates a three-wire cable



Conductor symbol for architectural drawings (shows only circuit control and does not indicate actual path of conductor).



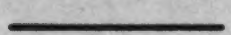
Conductor symbol with a note indicating three wires, size No. 4 (American Wire Gage), in a 1 1/2 inch diameter conduit.

In very complex electrical drawings, it may be necessary to indicate the direction a conduit or conductor turned. This helps trace circuits.

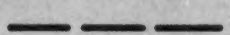
Wiring or Conduit Turned Up

Wiring or Conduit Turned Down

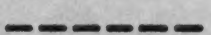
It may be necessary to indicate whether a conductor is concealed or exposed. The symbols below show how this is indicated.



Wiring Concealed in Ceiling or Wall

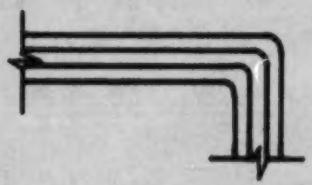


Wiring Concealed in Floor



Wiring Exposed

In some drawings, conductors are placed in ducts or "busways." The symbols may vary slightly; but, generally, they look like those below.



Wiring Duct or Trough

Wiring Duct or Busway

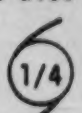
4. POWER DISTRIBUTION SYMBOLS

Because of the simplicity of some electrical diagrams, it is not necessary to show detailed symbols of each electrical component. Therefore, the symbols are simplified to squares or rectangles with letters to describe the electrical part. These parts are referred to as circuit elements. Some of these symbols are shown below.

CB	Circuit Breaker	RG	Recording Unit
R	Relay	DIAL	Dial Telephone
PE	Photoelectric Cell	TTY	Teletype Writer
FL	Filter	AR	Amplifier
PS	Power Supply	MIC	Microphone
T	Transformer	L.S	Loudspeaker

Motor and generators are also simplified symbols.

Motor



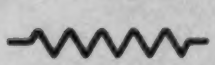
Motor w/ horsepower indicated

Generator

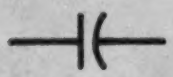
Metering devices are circles with designation letters inside the circle.

(A)	Ammeter	(OP)	Oil Pressure
(DB)	Decibel Meter	(PH)	Phase Meter
(F)	Frequency Meter	(T)	Temperature
(OHM)	Ohmmeter	(V)	Volt Meter
		(W)	Watt Meter
		(WH)	Watt-hour Meter

A few symbols remain independent of the drawing type. They are the same for all electrical and electronic wiring diagrams. These symbols are shown below.

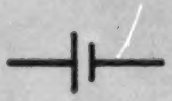


Resistor

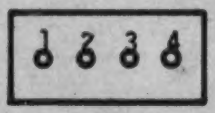


Capacitor

Transformer



Battery



Terminal Board

Ground

Self Assessment

Directions: Identify the following symbols in the space provided.
Check your answers on page 55.

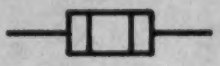
(1)

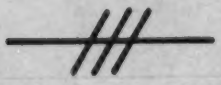
(2)

(3)

(4)

(5)

(6) 

(7) 

(8)

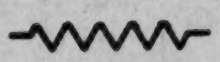
(9)

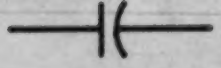
(10)

(11)

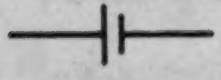
(12)

50

(13) 

(14) 

(15)

(16) 

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Answers to Self-Test:

(1) Single-Throw Switch
(2) Push Button Switch
(3) Knife Switch
(4) Relay
(5) Circuit Breaker
(6) Fuse
(7) Three-Wire Conductor
(8) Wiring Turned Down
(9) Exposed Conductor
(10) Power Supply
(11) 1/2 Horsepower Motor
(12) Volt Meter
(13) Resistor
(14) Capacitor
(15) Transformer
(16) Battery

Study Guide

For Further Information:

IEEE Standard and American National Standard, Graphic Symbols for Electrical and Electronic Diagrams, 1971, ANSI V32.2.

Electrical and Electronics Drawings, Baer, 1973.

National Electrical Code, 1975 Ed.

National Electrical Code Blueprint Reading, Gibert, 1974.

Electrical Blueprint Reading, Traister, 1975.

Electrical Trades Blueprint Reading, Vol. 1-3, Delmar Publish., 1961.

ILS Drafting: Electrical/Electronics, article 26.00

INDIVIDUALIZED LEARNING SYSTEMS

Drafting

Pipes

Valves

Miscellaneous Pipe Fittings

Goal:

The student will be able to identify some of the symbols used on drawings to show pipe fittings, valves and other hardware.

Performance Indicators:

Given graphic illustrations of piping symbols, the student will identify them by the commonly accepted industry term.

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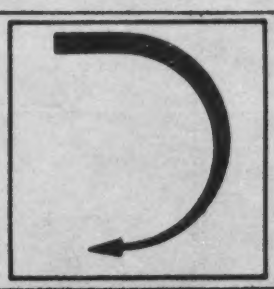
Introduction



Since large HVAC systems may include steam hot water or refrigerant, piping of these fluids is shown on drawings using standard symbols.

These symbols are designated by the American National Standards Institute as standard symbols for piping.

The symbols shown in this module are for fitting joints with screw threads. Flanged fittings, welded fittings, and soldered fittings have slightly different symbols. For examples of these, consult the references at the end of this module.

• Information

1. PIPES

Pipes are shown as single lines with a letter or letters to identify the fluid they carry. Pipes returning fluid to a unit are shown with dashed lines and pipes supplying fluid are shown with solid lines.

———— S ————

Supply Pipe, Steam

—— — — CR — — — —

Condenser Water
Return Pipe

Some of the letters used to describe fluids are listed below.

S - Steam Pipe

C - Condensate Return Pipe

HWS - Hot Water Supply Pipe

HWR - Hot Water Return Pipe

CWS - Cold Water Supply Pipe

CWR - Cold Water Return Pipe

HCS - Combination Hot-Cold Water Supply

HCR - Combination Hot-Cold Water Return

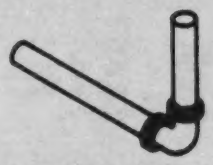
CS - Condenser Water Supply

CR - Condenser Water Return

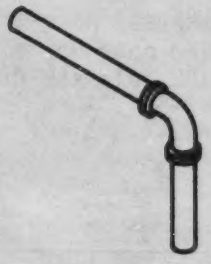
R - Refrigerant Pipe

Pipes that turn up or down from the horizontal are indicated by the symbols shown below.

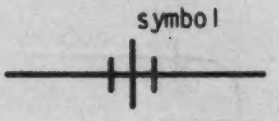
Pipe Turning Up

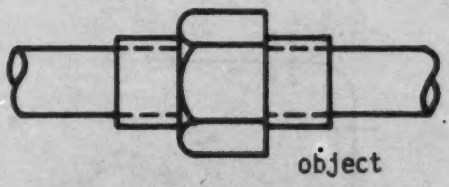


Pipe Turning Down

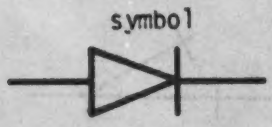


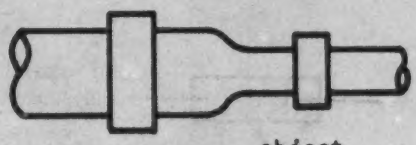
Pipes joined by a "union" are indicated with the symbol shown below.



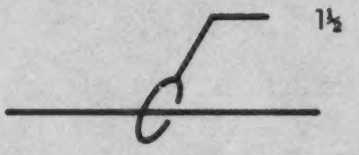


Reducers or joints where pipes of different diameters are joined are indicated by the symbol below.





Pipe sizes are indicated in a number of ways. Two of the more common methods of indicated pipe diameters are shown below.



2. VALVES

Valves are used to control volume of flow, direction of flow, and on-off control of flow in pipes. Gate valves are used for on-off control; globe valves are used for volume control; and check valves are used for controlling direction of flow.

Gate Valve

Globe Valve

Check Valve

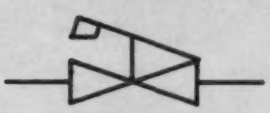
(arrow indicates direction fluid is allowed to flow)

Some of the other valves and valve symbols used in piping are shown below.

Diaphram Valve

Float Valve

Lockshield Valve



Quick-Opening Valve

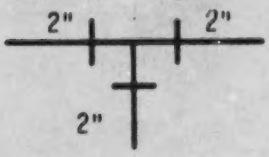
Safety Valve

Motor-Operated Valve

These valves perform special functions and are not commonly used. However, they may be encountered on some HVAC drawings.

3. MISCELLANEOUS PIPE FITTINGS

Some of the pipe fitting symbols that are frequently shown on HVAC drawings are listed below.

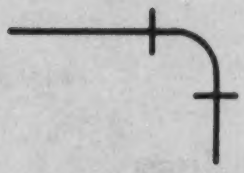


TEE

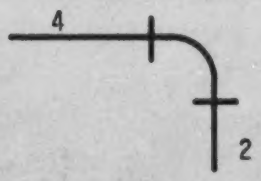
Pipes may be the same diameter or each may vary in diameter.

CROSS

Pipe sizes are shown in the same manner as for Tees.

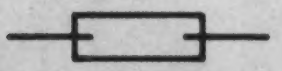


ELBOW



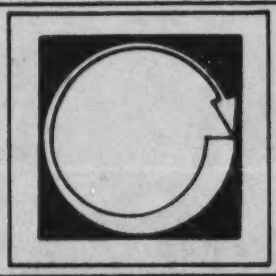
REDUCING ELBOW

LATERAL

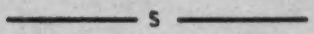


EXPANSION JOINT

Self Assessment



Directions: Identify the following piping symbols. Check your answers.

1. 

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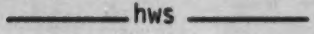
2. 

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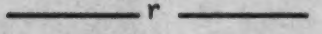
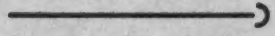
3. 

_____

4.
_____

5. 
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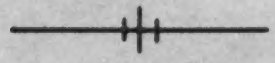
6. 
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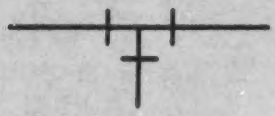
7.
_____

8.
_____

9.
_____

10.
_____

11. 
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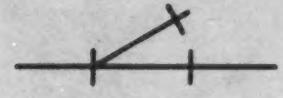
12.
_____

13. 
_____

60

Answers to Self-Test:

1. Steam Pipe
2. Hot Water Supply Pipe
3. Refrigerant Pipe
4. Pipe Turned Up
5. Pipe Turned Down
6. Union
7. Reducer
8. Gate Valve
9. Globe Valve
10. Check Valve
11. Tee
12. Elbow
13. Lateral

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Answers to Self-Test:

1. Steam Pipe
2. Hot Water Supply Pipe
3. Refrigerant Pipe
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9. Globe Valve
10. Check Valve
11. Tee
12. Elbow
13. Lateral

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Study Guide

For Further Information:

Graphical Symbols for Heating, Ventilating and Air Conditioning; American National Standards Institute.

Graphical Symbols for Pipe Fittings, Valves and Piping; American National Standards Institute.

Graphical Symbols for Plumbing; American National Standards Institute.

Architectural Graphic Standards; Ramsey and Sleeder, 6th Ed.

INDIVIDUALIZED LEARNING SYSTEMS

Drafting

Basic Symbols
Duct Hardware Symbols
Air Outlets and Inlets

Goal:

The student will be able to identify ducting symbols on HVAC drawings.

Performance Indicators:

Given graphic illustrations of ducting symbols, the student will identify them by the commonly accepted industry term.

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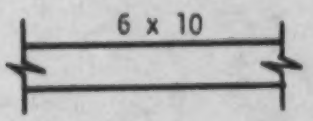
Introduction

One of the most common heating systems is the forced air system. It uses a series of ducts to deliver warm air to specific areas of a structure. Air conditioning and ventilation systems also use ducts to deliver air. Therefore, the most frequent information obtained from HVAC drawings is that which concerns the ducting system.

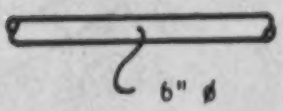
Information

1. BASIC SYMBOLS

Ducts may be rectangular or round and are normally shown on plans as a double line. The size of duct is indicated on the duct symbol or near it.

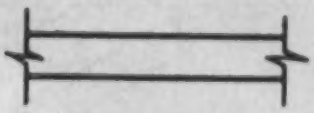


6"x10" Rectangular Duct
(indicated by 6"x10" ⌀)

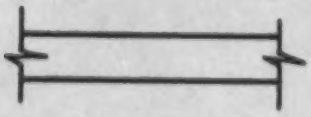


6" Diameter Round Duct
(indicated by 6" ⌀)

Ducts are distinguished as to whether they are supply ducts or return ducts by showing return ducts and their hardware as dashed lines and by showing supply ducts as solid lines.

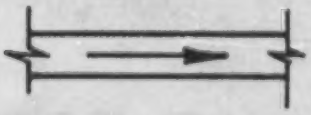


Supply

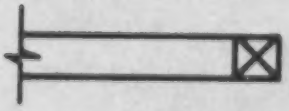


Return
(may be dashed lines or labeled as "return")

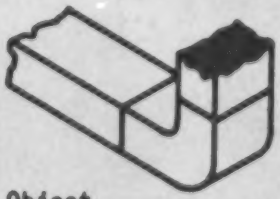
Direction of air flow may be indicated with an arrow.



A supply duct turned up is shown as:

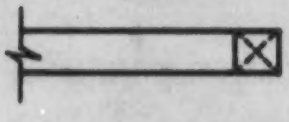


Symbol

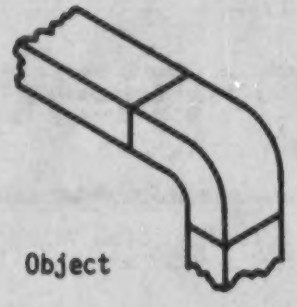


Object

A supply duct turned down is shown as:



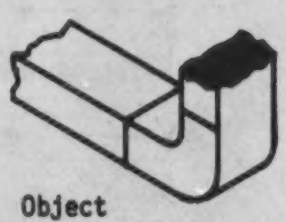
Symbol



Object

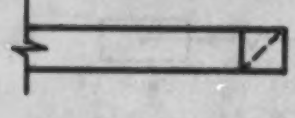
A return duct turned up is shown as:

Symbol

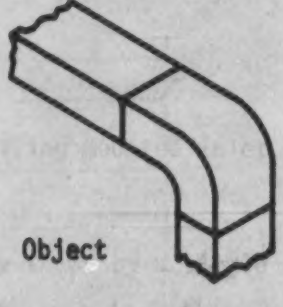


Object

A return duct turned down is shown as:



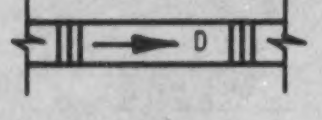
Symbol



Object

If the air flow in a duct is deflected upward or downward by vanes in the duct, it is indicated on the duct symbol as shown below.

Upward
(rising)



Downward
(dropping)

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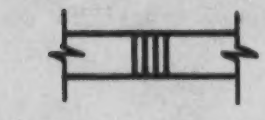
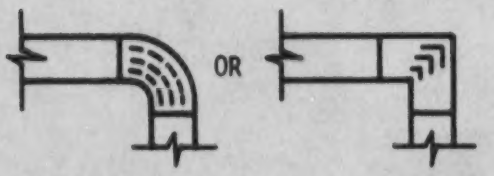
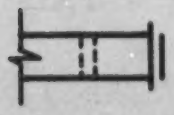
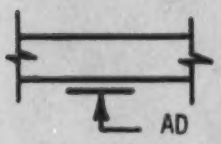
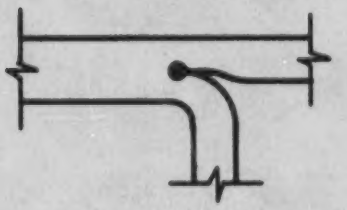
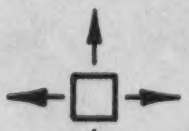
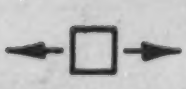
2. DUCT HARDWARE SYMBOLS

Symbol	Name
	Flexible Connection
	Turning Valves
	Adjustable Blank Off
	Volume Damper
	Access Door
	Deflecting Damper

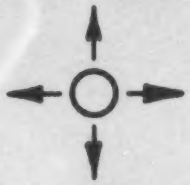
3. AIR OUTLETS AND INLETS

In a forced air heating system, warm supply air is released from the system by devices known as registers, louvers, or diffusers; and cold return air is taken into the system by devices called grills, louvers, or registers.

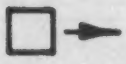
Supply Outlets:

	Four-Way Ceiling Diffuser
	Two-Way Ceiling Diffuser

Supply Outlets:



Round Four-Way Ceiling Diffuser

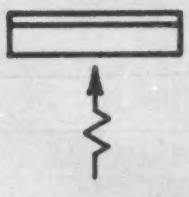


One-Way Ceiling Diffuser

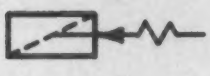
Base Board Register

Floor Register

Return Outlets:

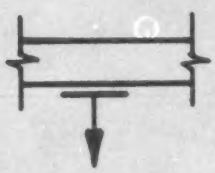


Wall Mounted Inlet

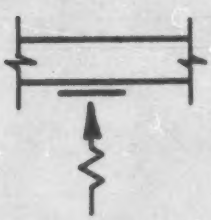


Ceiling Mounted Inlet

Louvered openings or grills are normally shown by a single line.



Supply Louver



Return Louver

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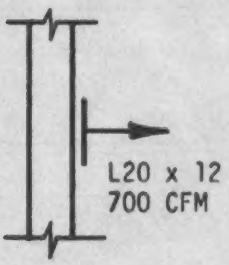
Duct inlets and outlets are labeled to indicate register or grill or louver size, air flow and direction of air flow.



20"x12" Louvered Opening
Air Flow = 700 cubic feet per minute

Some common abbreviations used on inlets and outlets are listed below.

L = Louver
D = Diffuser
R = Register
G = Grill
LD = Linear Diffuser
CD = Ceiling Diffuser
FR = Floor Register
TR = Top Register
CR = Center Register
BR = Bottom Register

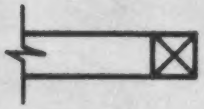
= Round

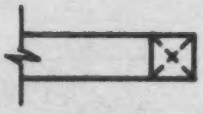
= Square or Rectangular

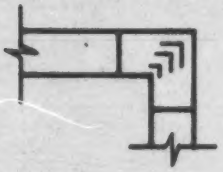
OA = Outside Air

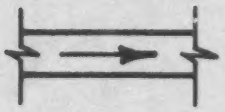
Self Assessment

Directions: Identify the following symbols.

1.  _____

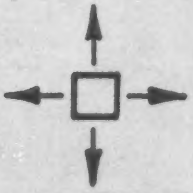
2.  _____

3.  _____

4.  _____

5. _____

6. _____

7.  _____

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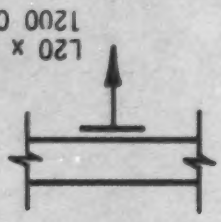
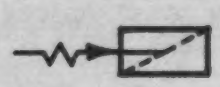
Answers:

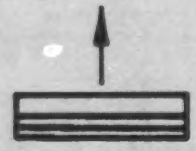
1. Supply Duct Turned Up; 2. Supply Duct Turned Down; 3. Turning Vanes; 4. Direction of Air Flow; 5. Deflecting Damper; 6. Volume Damper; 7. Four-Way Ceiling Diffuser; 8. Base Board Diffuser; 9. Ceiling Mounted Inlet; 10. 20"x20" Louvered Supply Outlet, Air Flow = 1200 CFM.

_____

_____

_____ 10. 

_____ 9. 

_____ 8. 

Study Guide

For Further Information:

Graphical Symbols for Heating, Ventilating and Air Conditioning; American National Standards Institute.

Sheet Metal Blueprint Reading for the Building Trades; Zinnegrabe, 1971.

Architectural Graphic Standards; Ramsey and Sleeper; 6th Ed.

INDIVIDUALIZED LEARNING SYSTEMS

Drafting

Heating Unit Symbols
Fans
Condensers
Compressors
Miscellaneous Symbols

Goal:

The student will be able to identify some of the symbols used to indicate heat, power and refrigeration apparatus on HVAC drawings.

Performance Indicators:

Given graphic illustrations of HVAC symbols for heat, power and refrigeration, the student will identify them by the commonly accepted industry term.

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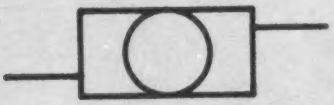
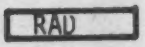
• Information

1. HEATING UNIT SYMBOLS

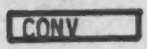


Boiler

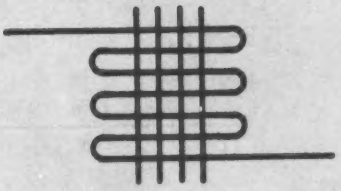


Radiator

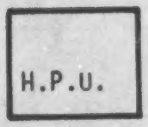
Forced Air Furnace



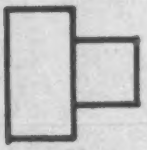
Convector



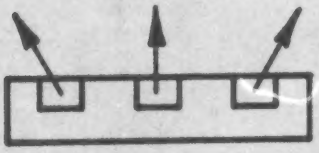
Heating Element



Heat Pump Unit



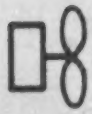
Unit Heater (Propeller)



Unit Heater (Centrifugal)

2. FANS

Centrifugal Fan

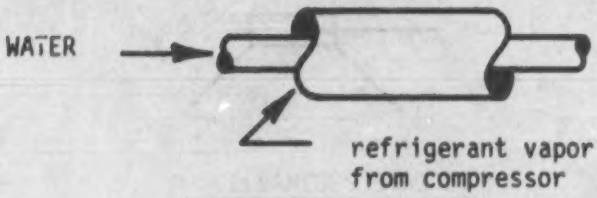


Propeller Fan

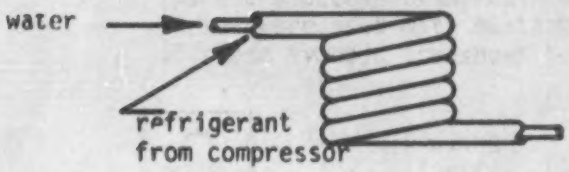
3. CONDENSERS

An important part of the air conditioning unit and system is the condensing unit, which may be a propeller or centrifugal fan-type condenser.

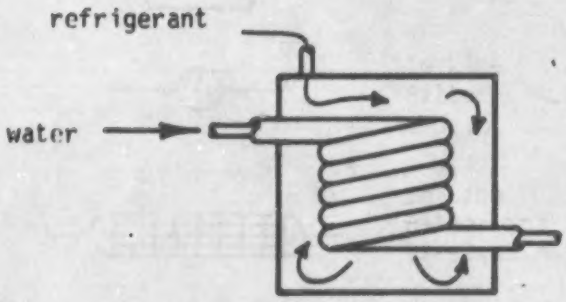
There are four basic types of water-cooled condensers. Each is shown below.



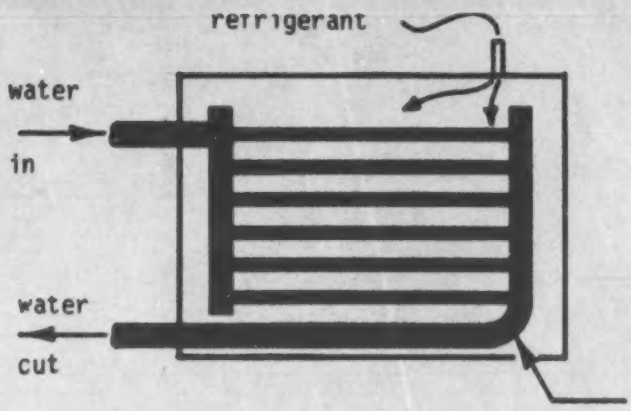
Double-Pipe Condenser



Double-Tube Condenser

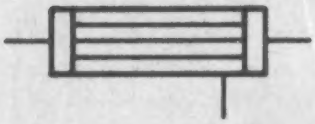


Shell and Coil Condenser

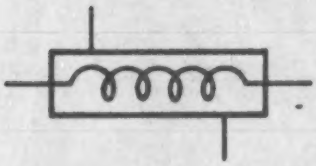


Shell and Tube Condenser

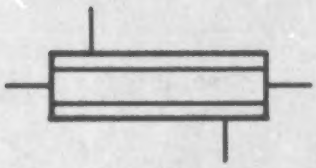
Condenser Symbols:



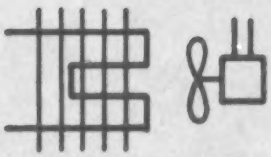
Water Cooled - Shell and Tube



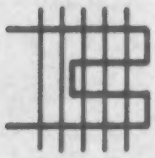
Water Cooled - Shell and Coil



Water Cooled, Double-Tube or Double-Pipe



Forced Air, Air Cooled, Finned



Static, Air Cooled, Finned

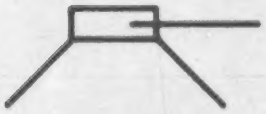
4. COMPRESSORS

Compressors are another important part of refrigeration and air conditioning units.

General Compressor Symbol

Belt-Driven, Rotary Compressor

Belt-Driven, Reciprocating Compressor

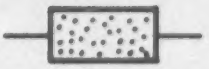


Direct Drive, Reciprocating Compressor

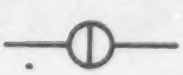
5. MISCELLANEOUS SYMBOLS

There are dozens of symbols used to describe various pieces of hardware used with heating and refrigeration units. Some of these symbols are shown below.

Cooling Tower

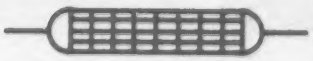


Dryer

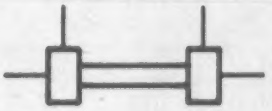


In-Line Filter

Gauge

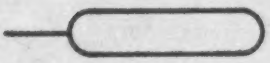


In-Line Filter and Strainer



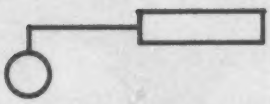
Heat Exchanger

Manifold-Type, Pinned Evaporator

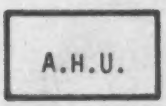


Thermal Bulb

Thermostat



Thermostat with Remote Bulb

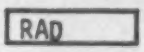


Air Handling Unit

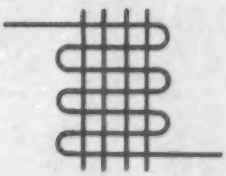
In-Line Pump

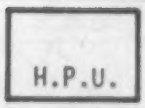
Self Assessment

Directions: Identify the following symbols. Check your answers.

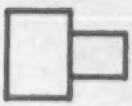
1. 

_____

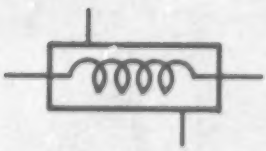
2. 
_____

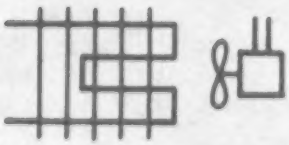
3. 

_____

4. 
_____

5.
_____

6. 
_____

7. 
_____

8.
_____

9.

_____

10.

_____

Answers:

1. Radiator; 2. Heating Element; 3. Heat Pump Unit; 4. Unit Heater; 5. Centrifugal Fan; 6. Coil and Shell Condenser; 7. Forced Air, Finned Evaporator; 8. Compressor; 9. Gauge; 10. Thermostat

Study Guide

For Further Information:

Graphical Symbols for Heating, Ventilating and Air Conditioning;
American National Standards Institute.

Architectural Graphic Standards; Ramsey and Sleeper; 6th Ed.

Drafting

Isometrics

Sections

Detail Drawings

Goal:

The student will be able to read some of the isometric, detail and section drawings used to show HVAC hardware.

Performance Indicators:

Given a detailed drawing showing symbols of HVAC hardware and a written test, the student will complete the test providing the information requested.

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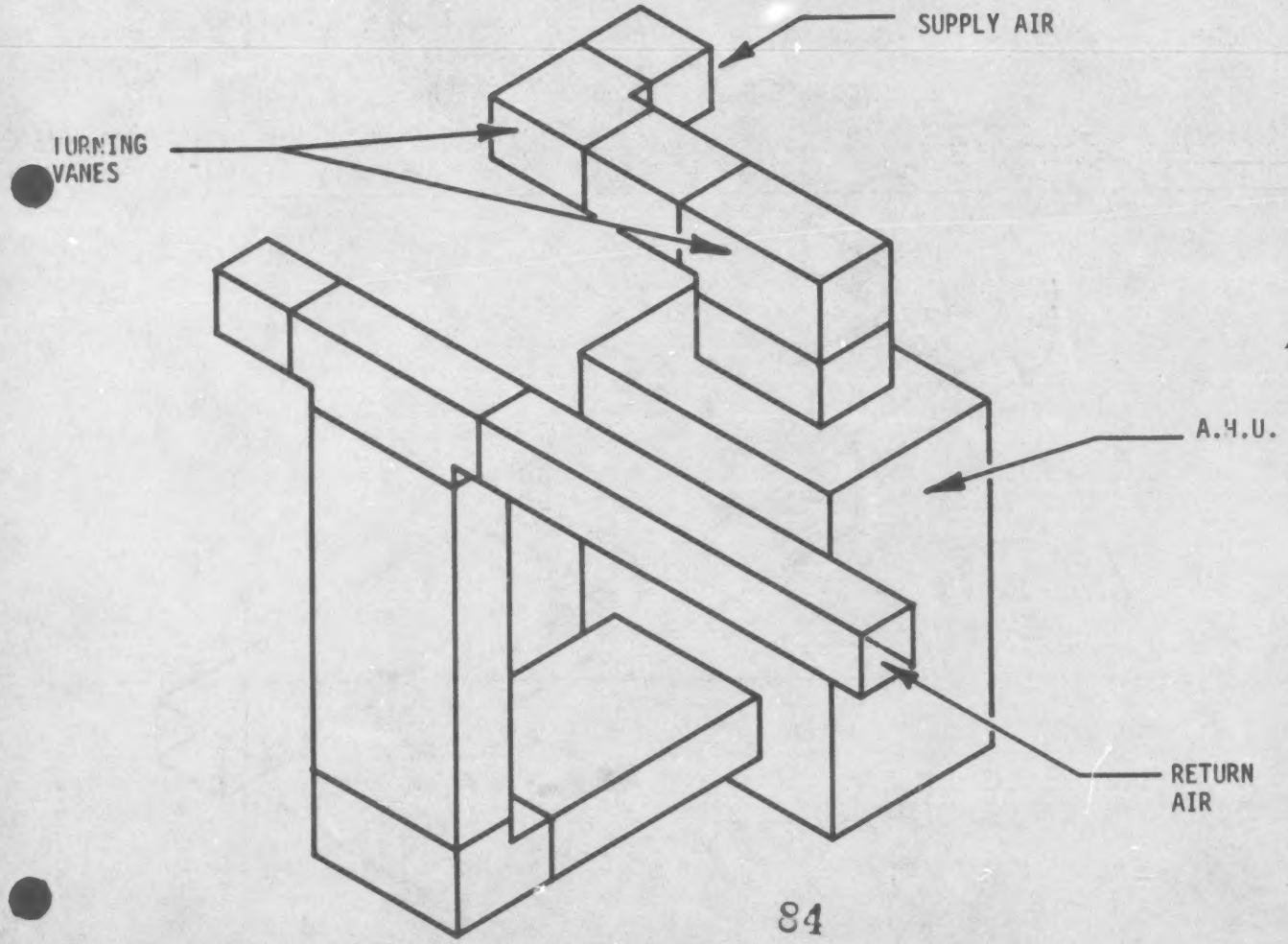
Information

1. ISOMETRICS

Isometric drawings are frequently used to show detailed information about ducting and other HVAC hardware. Since isometrics are in a pictorial form, they are easily read and understood by technicians and contractors.

Some examples of isometric drawings are shown below.



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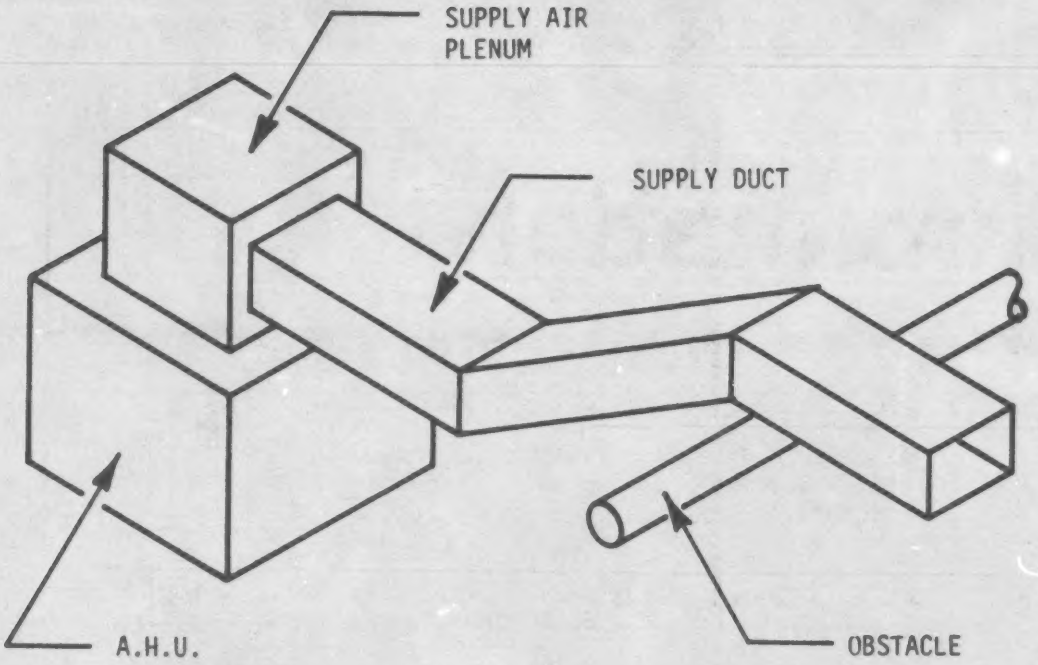
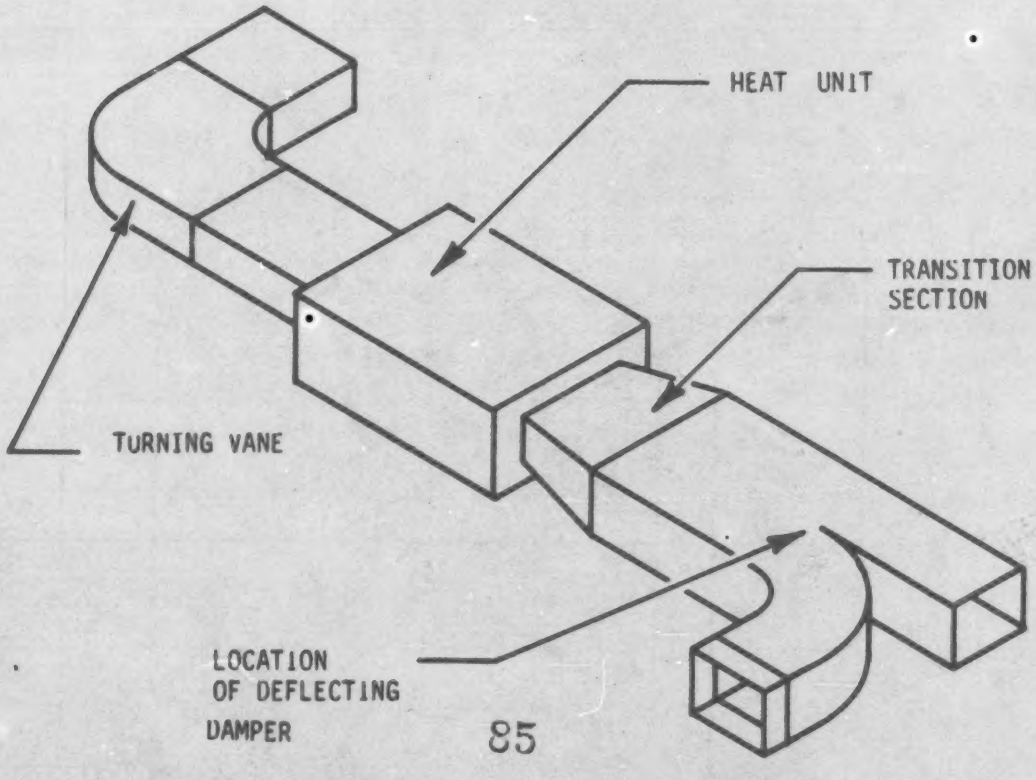
ISOMETRIC OF A.H.U. DUCTING



ISOMETRIC OF DUCTING OVER AN OBSTACLE



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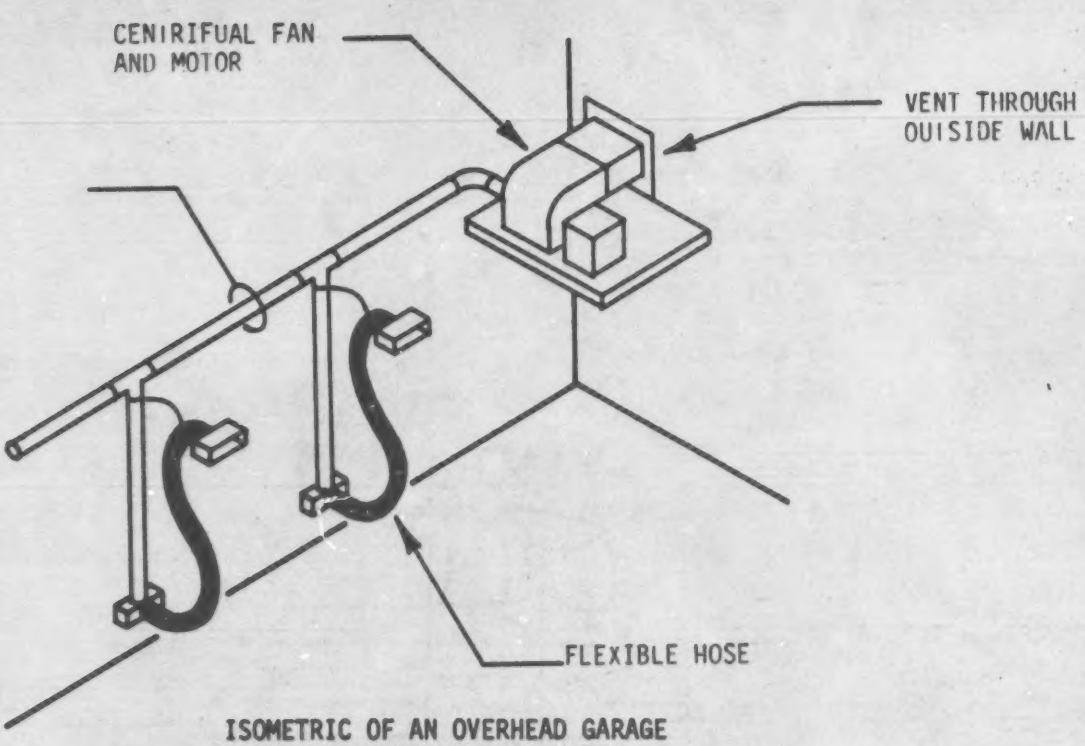
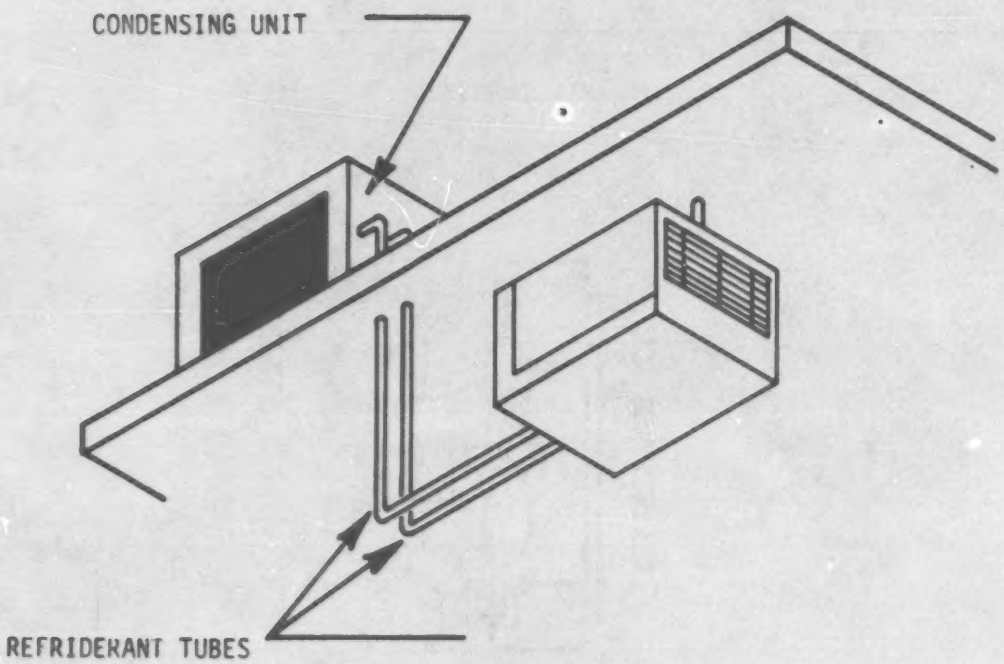
ISOMETRIC OF A HORIZONTALLY MOUNTED HEATING UNIT



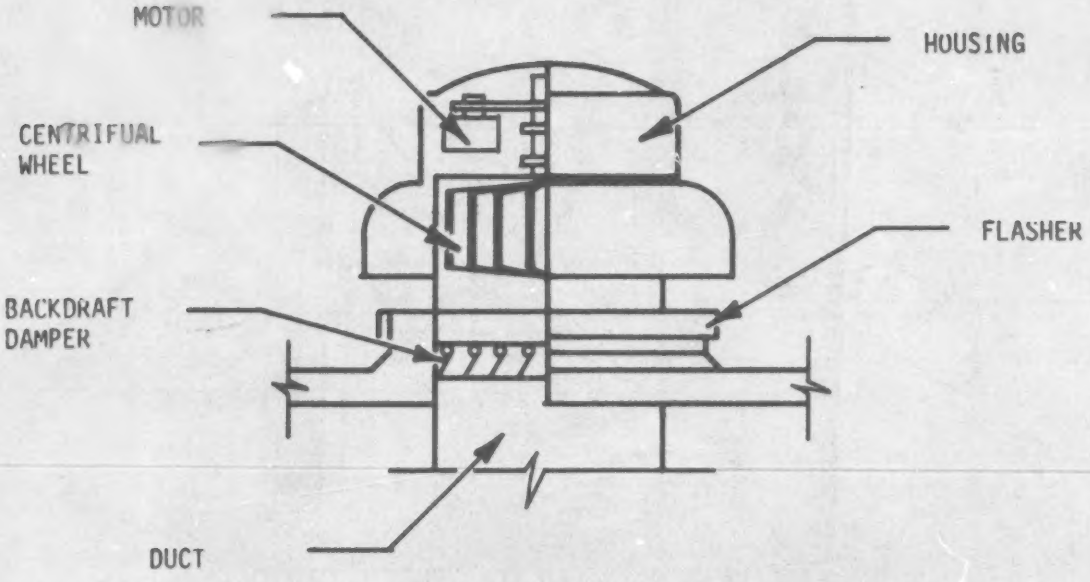
ISOMETRIC OF AN OVERHEAD GARAGE
EXHAUST VENTILATING SYSTEM



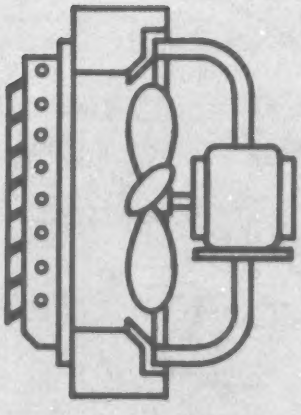
ISOMETRIC OF AN AIR CONDITIONING UNIT
WITH A ROOF MOUNTED CONDENSER

2. SECTIONS

Sectional views of HVAC hardware are often used to help explain interior equipment and details. Some examples are shown below.



HALF SECTION OF A ROOF VENTILATOR UNIT



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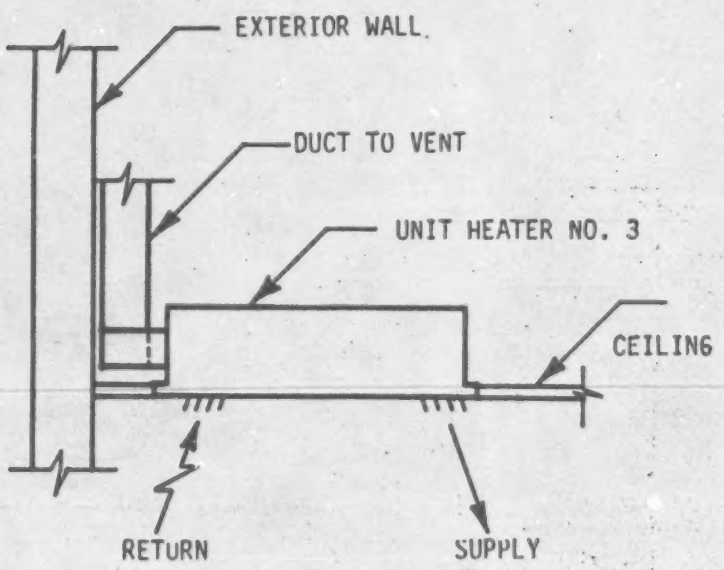
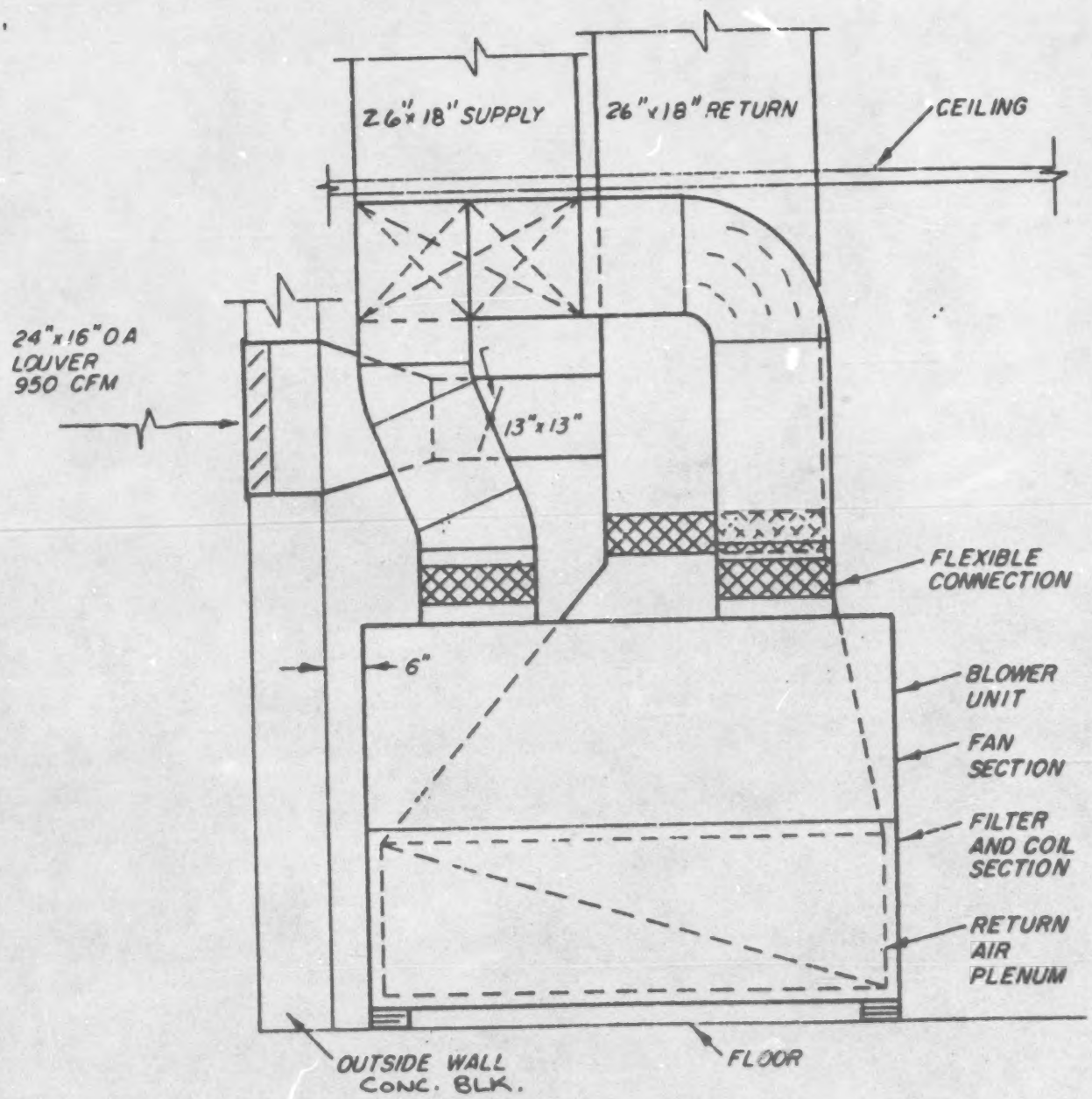
FULL SECTION OF A PROPELLER FAN UNIT

3. DETAIL DRAWINGS

Detail drawings show system installations in full or in part. They include piping, ducting and all essential hardware for the system. Some examples are shown below.



UNIT HEATER NO. 3
INSTALLATION DETAIL



BLOWER UNIT DETAIL

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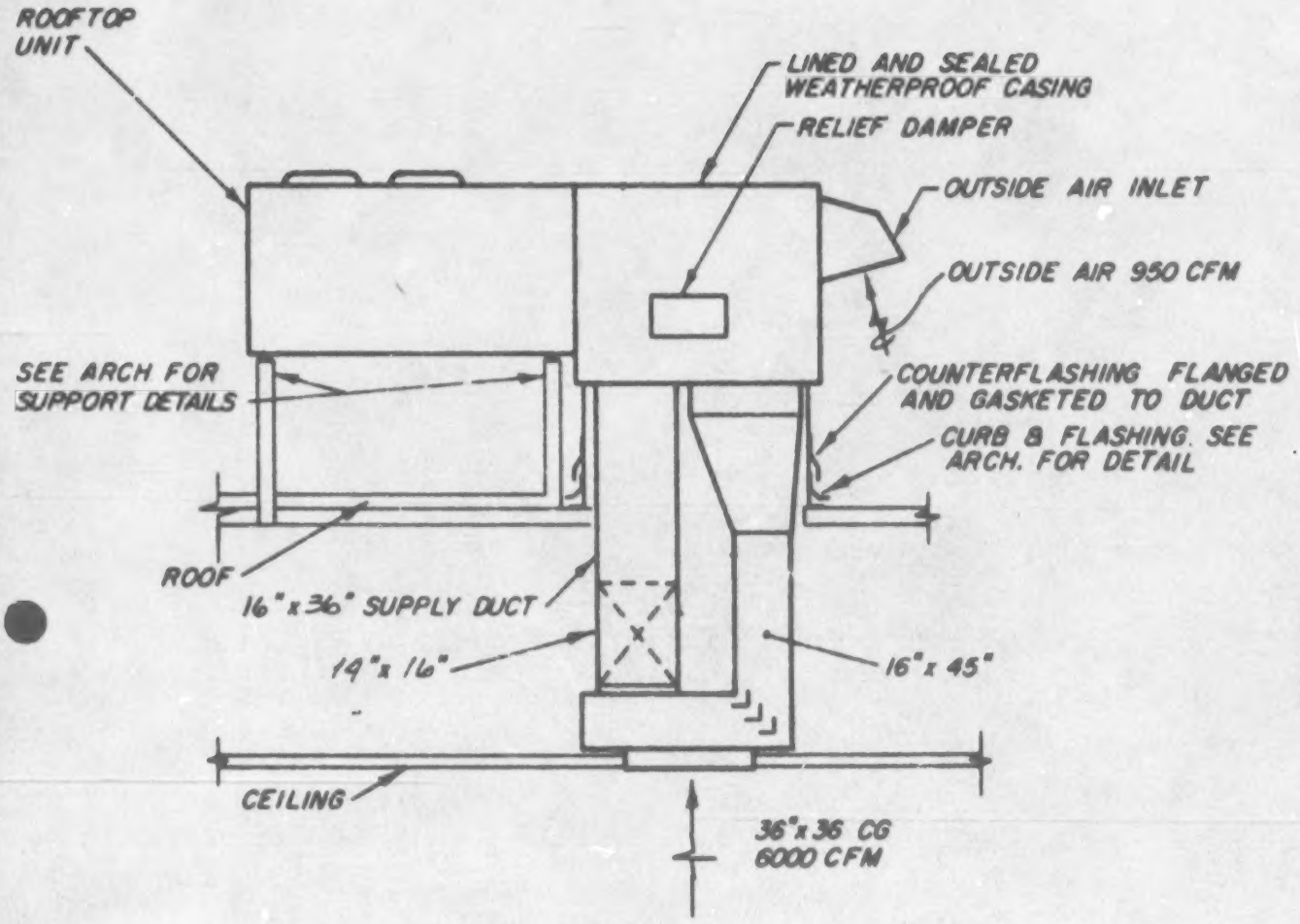


ROOF TOP VENTILATOR SYSTEM DETAIL

Self Assessment

Directions: Refer to the detail drawing on the next page to answer the following questions.

1. How many air handling units are shown on the drawing? _____

2. What size grill opening provides outside air to air handling unit No. 3? _____

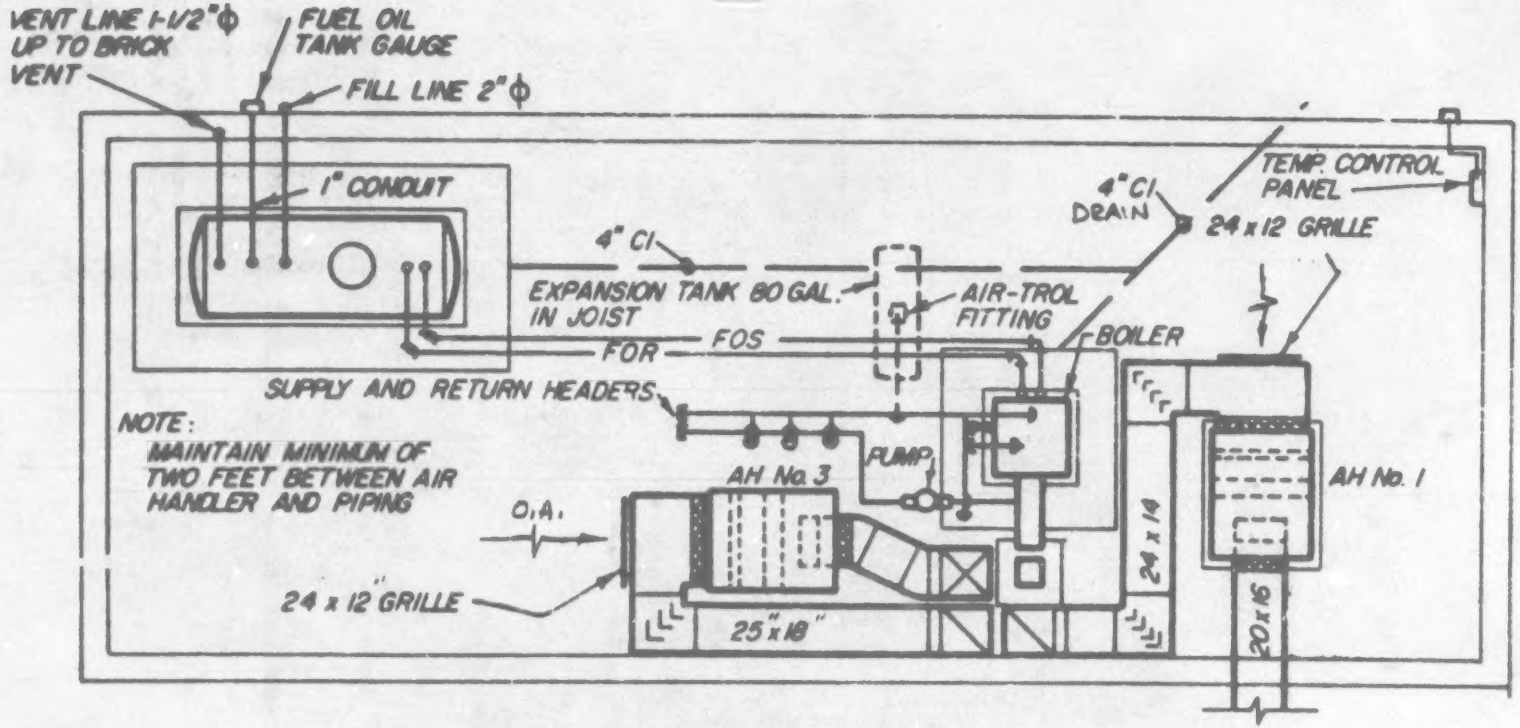
3. What is the capacity of the expansion tank? _____

4. What type of pump is shown connected to the boiler? _____

5. What is the size of the supply air duct from A.H. No. 1? _____

6. What is the minimum clearance between the air handlers and piping? _____

7. What does "FOS" and "FOR" mean on the pipe labels between the fuel oil tank and the boiler? _____



MECHANICAL EQUIPMENT ROOM PLAN

Answers to Self-Test:

1. Two Pump; 2. 24" x 12"; 3. 80 Gal.; 4. In-Line;
5. 20 x 16; 6. 2 Ft.

Study Guide

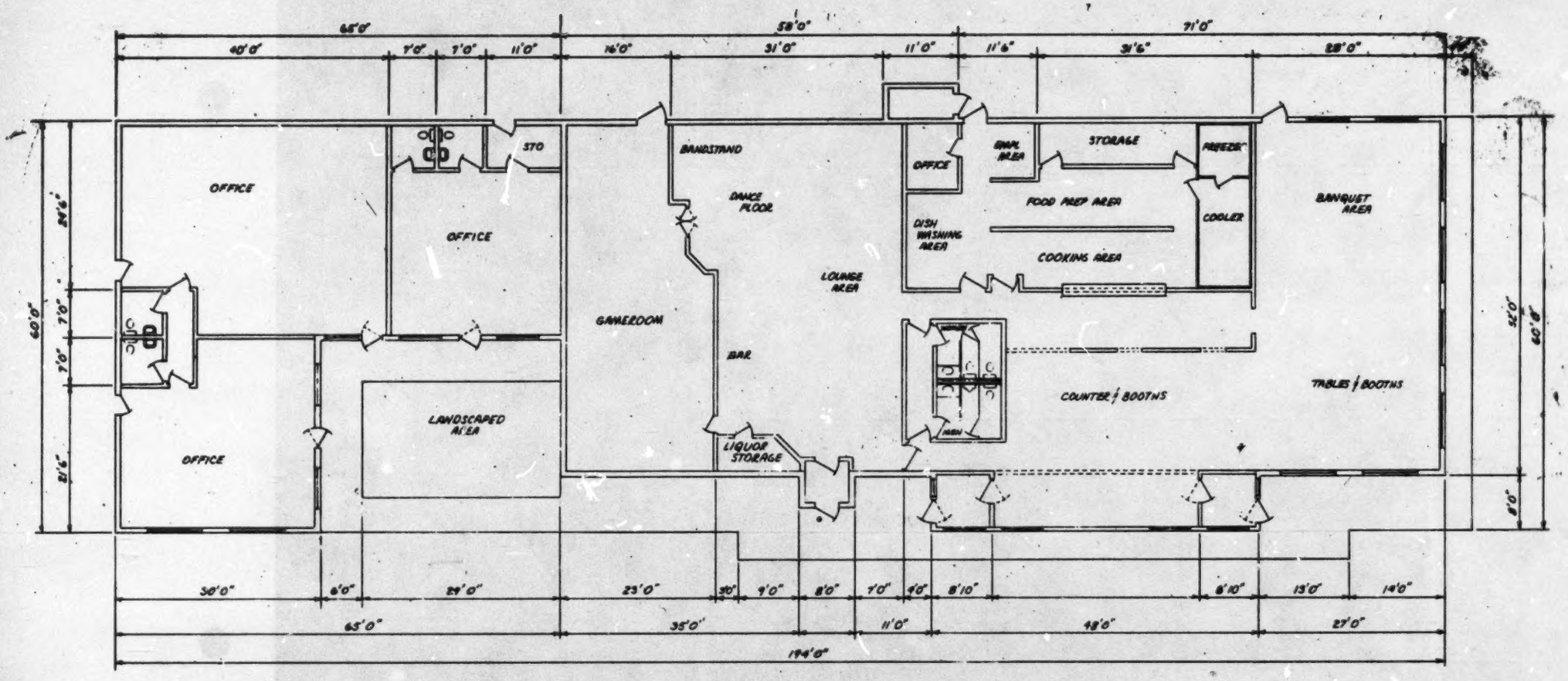
For Further Information:

Graphical Symbols for Heating, Ventilating and Air Conditioning; American National Standards Institute.

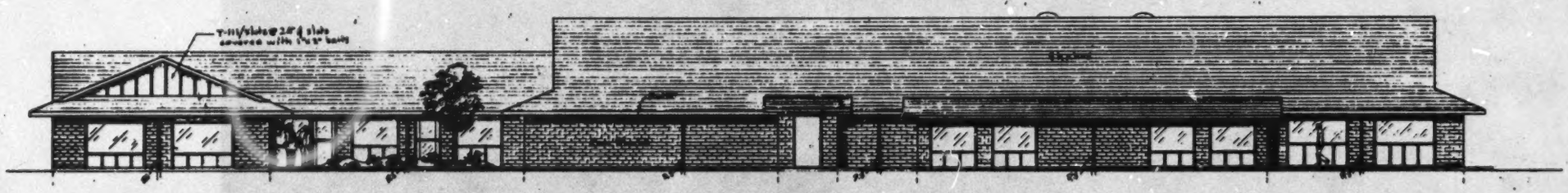
Sheet Metal Blueprint Reading for the Building Trades; Zinnegrabe, 1971.

Architectural Graphic Standards; Ramsey and Sleeper; 6th Ed.

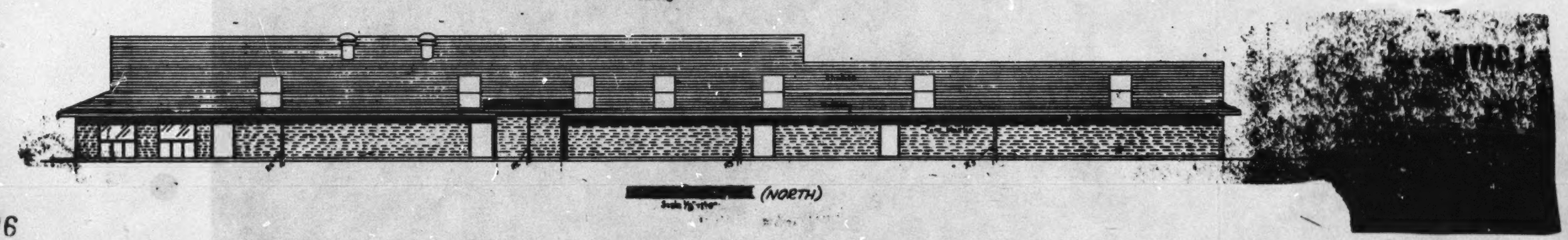
FINAL QUIZ IS AN INDUSTRY DRAWING!



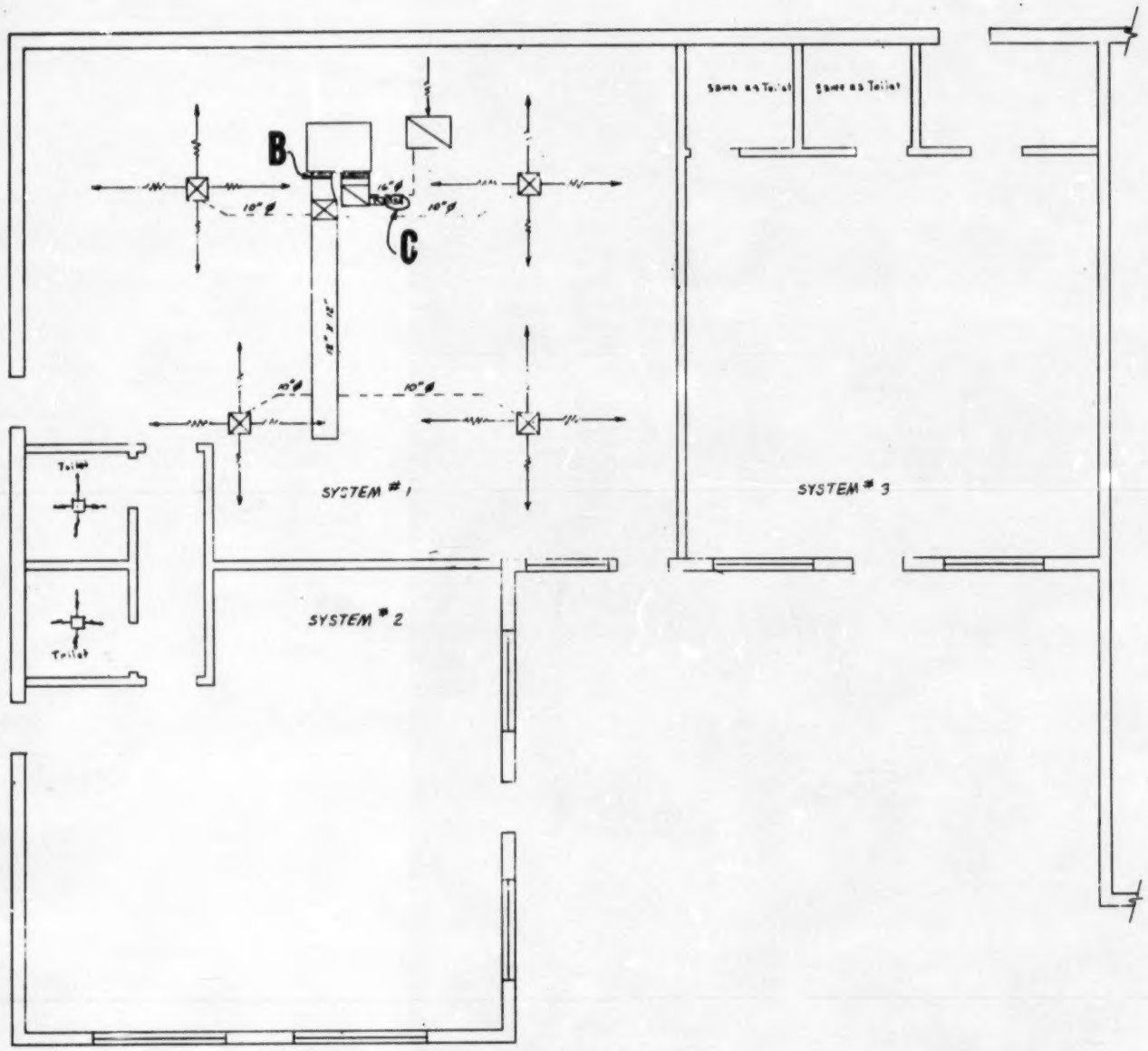
1/8" = 1'0"



(SOUTH)



(NORTH)



SYSTEM # 1
CARRIER MODEL # 50MQ037 3 TON HEAT PUMP
W/ 12 KW AUX ELECT HEATERS

SYSTEM # 2
CARRIER MODEL # 50 MQ022 2 TON HEAT PUMP
W/ 10 KW AUX ELECT HEATERS

SYSTEM # 3
SAME AS SYSTEM # 2

NOTES:

- ALL ROOF DUCTWORK TO HAVE 1" DUCTLINER - ATTIC DUCTWORK TO HAVE ½" DUCT LINER
- ALL ROUND DUCTWORK ø TO BE FIBERGLASS FLEX DUCT
- OUTSIDE AIR DUCT TO PROVIDE 10% OUTSIDE AIR 140 CFM

OFFICE MECHANICAL PLAN

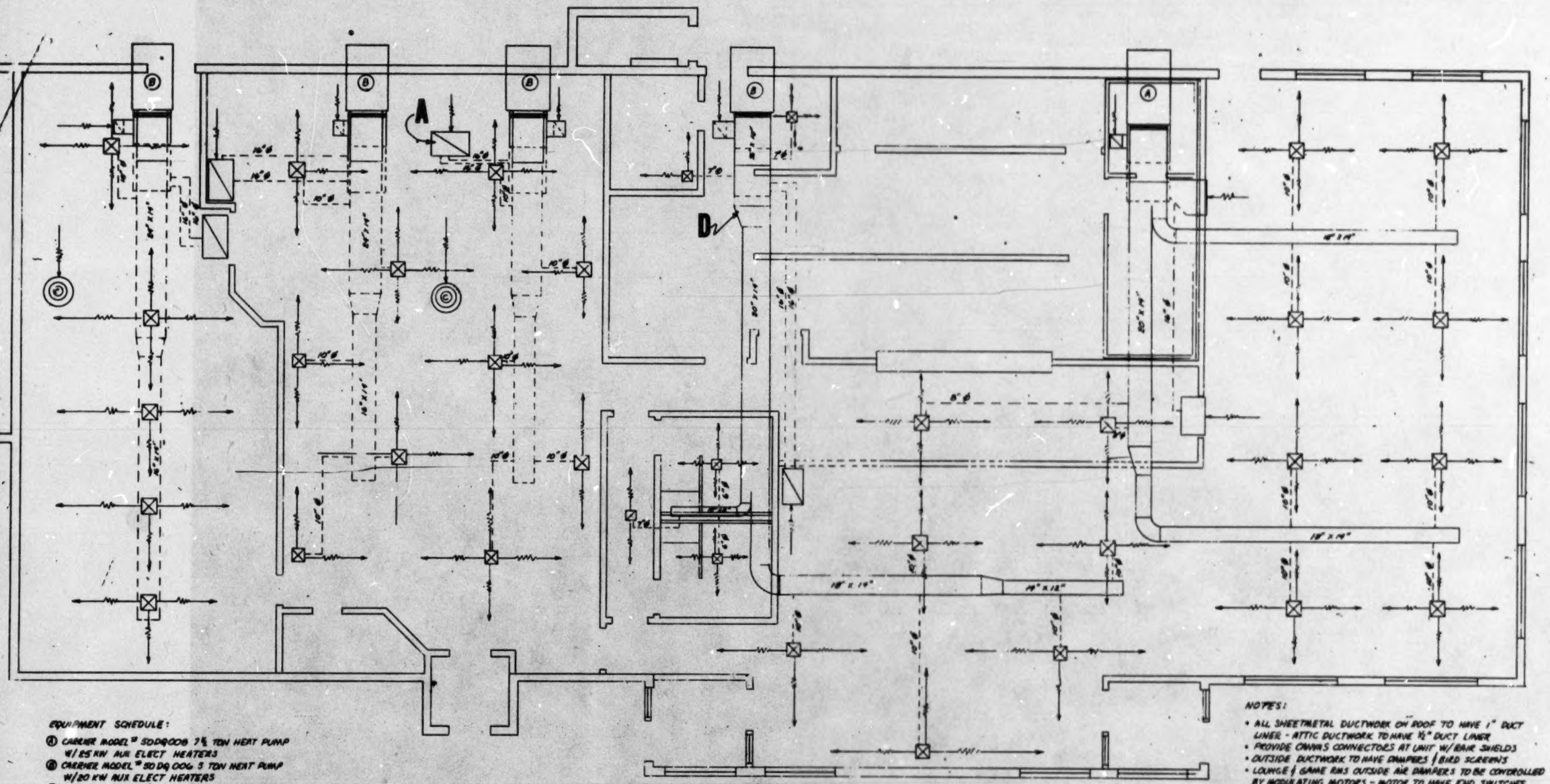
¼" = 1'0"

FINAL QUIZ **HVAC 2**

OFFICE
MECHANICAL PLAN

DARRELL'S RESTAURANT
DEAN OGDEN - OWNER
CORVALLIS - OREGON

REGISTERED ARCHITECT
STATE OF OREGON



1/4" = 1'0"

EQUIPMENT SCHEDULE:

(A) CARRIER MODEL # 50RQ008 7½ TON HEAT PUMP W/ 15 KW AUX ELECT HEATERS
(B) CARRIER MODEL # 50 DQ 006 5 TON HEAT PUMP W/20 KW AUX ELECT HEATERS
(C) CHELSEA MODEL # RDD 122 AC. ROOF EXHAUST FAN WITH TWO SPEED MOTOR

DIFFUSER SCHEDULE:

(D) ALL CEILING DIFFUSERS TO BE HART & COOLEY # 89 W/PE DAMPER. SIZES TO BE GIVEN WHEN JOB IS LET CONSULT WITH ELECTRICAL CONTRACTOR REGARDING LOCATION OF EXHAUST FANS & DIFFUSERS

NOTES:

- ALL SHEETMETAL DUCTWORK ON ROOF TO HAVE 1" DUCT LINER - ATTIC DUCTWORK TO HAVE ½" DUCT LINER
- PROVIDE CANVAS CONNECTORS AT UNIT W/ RAIN SHIELDS
- OUTSIDE DUCTWORK TO HAVE DAMPERS & BIRD SCREENS
- LOUNGE & GAME RMS OUTSIDE AIR DAMPERS TO BE CONTROLLED BY MODULATING MOTORS - MOTOR TO HAVE END SWITCHES WHICH WILL CONTROL ROOF EXHAUST FANS
- OUTSIDE AIR FROM BANQUET & BOOTH AREAS TO BE EXHAUSTED THROUGH KITCHEN EXHAUST SYSTEM
- ALL DIMENSIONS APPROX. TO BE CONFIRMED IN THE FIELD
- ALL ROUND ⌀ DUCT TO BE FIBERGLASS FLEX. DUCT

FINAL QUIZ **HVAC 3**

RESTAURANT
MECHANICAL PLAN

REGISTERED ARCHITECT · STATE OF OREGON

PARRELL'S RESTAURANT
DEAN OSDEN - OWNER
CORVALLIS - OREGON

Clive N. Jackson A.I.A.
ARCHITECT
Corvallis - Oregon